Copy No. 7

DEFENCE R&D DÉFENSE

USER'S MANUAL FOR **WAVELOAD** Version 1: A Computer Program for the Prediction of Ship Motions, Hydrodynamic Pressure Distribution and Sea Loads

C.C. Hsiung – Z.J. Huang – W. Qiu

Centre for Marine Vessel Development and Research

DEFENCE RESEARCH ESTABLISHMENT ATLANTIC

Contractor Report

DREA CR/98/445

National Defence Défense nationale

November 1998

Canada

102-02833/

National Defence
Research and Development Branch

Défense nationale
Bureau de recherche et développement

DREA CR/98/445

USER'S MANUAL FOR **WAVELOAD** VERSION 1

A Computer Program for the Prediction of Ship Motions, Hydrodynamic Pressure Distribution, and Sea Loads

C.C. Hsiung – Z.J. Huang – W. Qiu

Centre for Marine Vessel Development and Research
DalTech, Dalhousie University
P.O. Box 1000,Halifax, NS
B3J 2X4

Scientific Authority S. Ando

W7707-7-4636
Contract Number

November 1998

CONTRACTOR REPORT

Prepared for

Defence Research Establishment Atlantic

Centre de Recherches pour la Défense Atlantique

Canada

ABSTRACT

WAVELOAD is a computer program which has been developed to provide a numerical tool for predicting ship motions, sea loads and the hydrodynamic pressure distribution over the wetted hull surface in the frequency domain. The computations are based on the three-dimensional panel method using zero-speed Green's function with forward speed correction. The *m*-term effect on the ship motion is considered.

This manual describes how to install and operate the WAVELOAD version 1.0 program on a FreeBSD UNIX system. The structure of the input and output data files are described in detail. Example files are also included in this manual.

RÉSUMÉ

WAVELOAD est un programme informatique conçu en vue de fournir un outil numérique permettant de prédire, dans le domaine fréquentiel, les mouvements d'un navire, les charges de mer et la distribution des pressions hydrodynamiques exercées sur une surface de coque mouillée. Les calculs se fondent sur la méthode des panneaux tridimensionnels utilisant la fonction de vitesse nulle de Green avec une correction de vitesse avant. Les effets du terme *m* sur le mouvement du navire sont aussi inclus.

Le présent manuel décrit la manière d'installer et d'exploiter le programme WAVELOAD, version 1.0, tournant sous un système FreeBSD UNIX. Les structures des fichiers d'entrée et de sortie sont décrits en détail. Des exemples de fichiers sont aussi compris dans le manuel.

Contents

OVERVIEW OF PROGRAM "WAVELOAD" 2

1 Part I: Installation 4

2 Part II: Input Data File Description 5

2.1 Introduction 5

2.2 Format of <filename>.ctrl 6

2.3 Format of <filename>.panel 10

2.4 Format of <filename>.damp 14

3 Part III - Output Data File Description 22

3.1 Introduction 22

3.2 Nondimensionalizations 23

3.3 Format of <filename>.out 25

3.4 Format of <filename>.chk 28

3.5 Format of <filename>.pre 30

REFERENCES 31

Appendix I: Definitions of the Coordinate System and Ship Motions 32

Appendix II: The s60c08.ctrl File 35

Appendix III: The s60c08.panel File 36

Appendix IV: The s60c08.damp File 44

Appendix V: The s60c08.out File 46

Appendix VI: The s60c08.chk File 51

Appendix VII: The s60c08.pre File 66

OVERVIEW OF PROGRAM "WAVELOAD"

The program "WAVELOAD" was developed at the Centre for Marine Vessel Development and Research (CMVDR) by modifying the program SMCA4 [1,2]. The code is written in FORTRAN 77 ANSI. The flow chart is shown in Figure 1.

The main purpose of "WAVELOAD" is to provide the ship designers and analyzers with a numerical tool to predict ship motions, sea loads and particularly the hydrodynamic pressure distribution over the wetted hull surface in the frequency domain. The computation is based on the three-dimensional panel method using zero-speed Green's function with forward speed correction. The m-term effect on ship motion is considered. The steady flow disturbance potential is considered and determined by the double-body flow which is computed by the Hess-Smith method.

In the code development, it is assumed that the ship is symmetrical about the longitudinal centerplane. The field points are located on the port side of the hull surface and the sources are distributed on both port and starboard sides of the hull surface.

This manual is to be used to operate WAVELOAD V1.0.

This manual consists of three parts. Part I provides users with the information on installation. Part II is concerning with the detailed description on the input data files. Part III gives the explanation on the output variables. The input and output example files are attached as Appendices, II to VII. The definitions of the coordinate system and ship motions are provided in Appendix I of this manual.

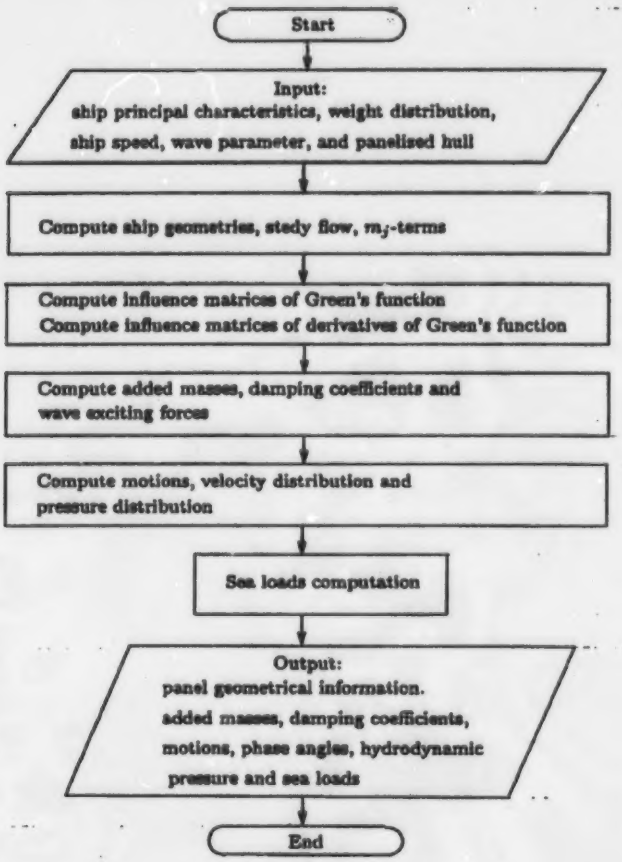

Figure 1: Flow Chart of WAVELOAD

1 Part I: Installation

This part is associated with the installation and running of the WAVELOAD program.

The source code of the program is supplied and can be installed to the hard disk of computer with UNIX operating system. It should be noted that the computer must have a **minimum of 32 Mbytes of RAM**.

The installation is quite simple.

1. Make a directory named WAVELOAD
2. Copy waveload.f to WAVELOAD by using *cp* or *ftp*
3. Compile waveload.f by using *f77 waveload.f -o waveload*, then the executable file *waveload* is generated

2 Part II: Input Data File Description

2.1 Introduction

There are three input data files for WAVELOAD:

<filename>.ctrl	**contains ship dimensions, weight distribution, wave parameters, headings, and other control data.**
<filename>.panel	**contains the data for hull panelization.**
<filename>.damp	**contains data for the ship viscous roll damping coefficient computation.**

It is noted that <filename> is a user-given alphanumeric title up to 15 characters in length.

2.2 Format of <filename>.ctrl

The file <filename>.ctrl provides the necessary data for the ship's principal characteristics, weight distribution, wave parameters, headings and other control data.

In the file **<filename>.ctrl**, the following data must be provided:

Record(a), Ship Identification and Date of Computation

sname, date (alphanumeric characters)

sname : ship identification, 50 alphanumeric characters
with single-quotation marks, e.g. 'Series 60 $C_B = 0.7$'

date : date of computation, 25 alphanumeric characters
with single-quotation marks, e.g. 'June 15, 1998'

Record(b), Control Parameters

kseaload, *kdamp*, *kmterm* (4 integers)

kseaload : if kseaload=1, sea load computation is performed; if kseaload=0, sea load computation is not performed

kdamp : if kdamp=1, the viscous damping coefficient computation is performed; if kdamp=0, the viscous damping coefficient computation is not performed

kmterm : if kmterm=1, the full m-term effect computation is performed; if kmterm=0, the simplified m-term effect computation is performed

Record(c), Ship's Principal Particulars

L, *B*, *T*, *vol*, *xg*, *yg*, *zg*, f_n, *cb* (9 real numbers)

L :	ship length between perpendiculars (m)
B :	ship beam (m)
T :	ship draught (m)
vol :	volume displacement of the ship (m^3)
xg :	x-coordinate of c.g. of ship relative to midships (m)
yg :	y-coordinate of c.g. of ship relative to centerline (m)
zg :	z-coordinate of c.g. of ship relative to calm waterline (m)
fn :	the Froude number
cb :	block coefficient

Record(d), Ship Weight Distribution

ri44, *ri55*, *ri66*, *fw*, *fmom*, *fmomi*, *fmomt*, *xps* (8 real numbers)

ri44 :	roll radius of gyration of the ship (m)
ri55 :	pitch radius of gyration of the ship (m)
ri66 :	yaw radius of gyration of the ship (m)
fw :	Δ_F/Δ, mass fraction forward of section C_x
fmom :	$f_F\Delta_F/L_{pp}\Delta$, nondimensional first moment about section C_x of mass forward of C_x
fmomi :	$\sqrt{I_{LF}/L_{pp}^2\Delta}$, nondimensional second moment about section C_x of mass forward of C_x
fmomt :	$\sqrt{I_{TF}/B^2\Delta_F}$, nondimensional transverse radius of gyration
xps :	location relative to midships of section C_x for load computations (m),

xps is positive if C_x forward of midships

For the above parameters, additional parameters are defined as follows:

f_F the longitudinal distance from C_x to the C.G. of the portion forward of C_x

I_{LF} the longitudinal moment of inertial of the portion of the ship forward of C_x about C_x

I_{TF} the transverse moment of inertial of the portion of the ship forward of C_x about the longitudinal axis

Δ_F the weight of the portion of the ship forward of C_x

C_x the cross-section where the sea loads are computed

Record(e), Incident Wave Parameters

wmp:	*real*
nangle:	*integer*
wangle(1):	*real*
wangle(2):	*real*
.....	.
.....	.
wangle(nangle):	*real*
nw1	*integer*
wslr(1)	*real*
wslr(2)	*real*
.....	.
.....	.
wslr(nw1)	*real*

wmp :	incident wave amplitude (m)
nangle :	total number of incident wave headings
wangle(nangle) :	wave headings (deg), 180 degrees for head seas
nwl :	total number of wave-length to ship-length ratios
wslr(nwl) :	wave-length to ship-length ratios

As an example, **s60c08.ctrl** for Series 60 $C_B = 0.8$ is given in Appendix II.

2.3 Format of <filename>.panel

The underwater hull surface of the port side is divided into a finite number of quadrilateral panels. The nodes are arranged in the order as shown in Figure 2. We look at the panels from inside of the hull. The panelization program, PANELGEN [3], can be used as a tool to prepare this file.

It is noted that the MAXIMUM number of panels is **350**, and the MAXIMUM of nodal points is **500** in WAVELOAD V1.0.

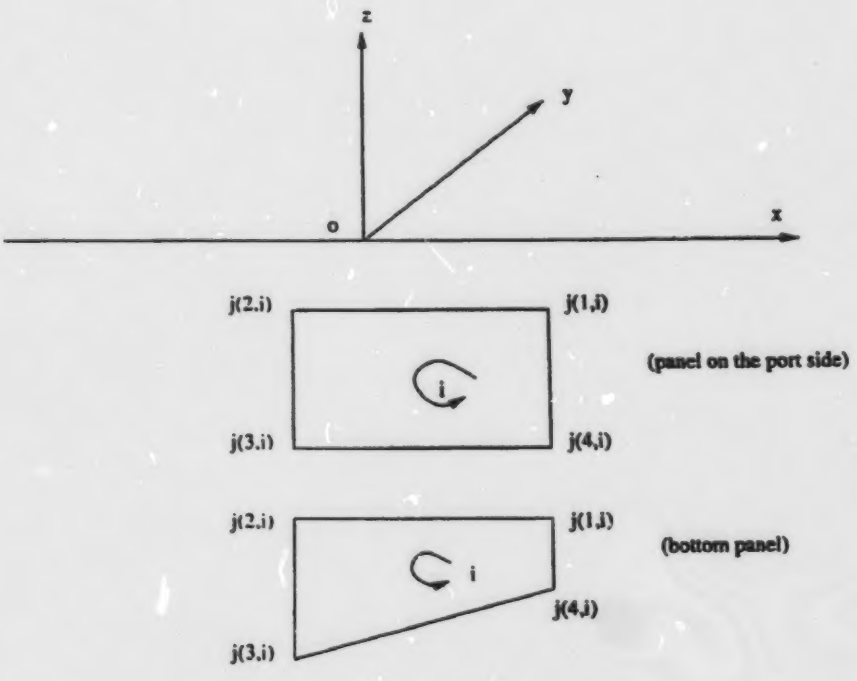

Figure 2: Connectivity Information on Panels

In <filename>.panel , the following data must be provided:

Record(a), Nodes and Panels on Ship Surface

np, *ne* (2 integers)

1	x(1)	y(1)	z(1)	(1 integer, 3 real numbers)
2	x(2)	y(2)	z(2)	
3	x(3)	y(3)	z(3)	
..	..	..	..	
I	x(I)	y(I)	z(I)	
..	..	..	..	
np	x(np)	y(np)	z(np)	

1	j(1,1)	j(2,1)	j(3,1)	j(4,1)	(5 integers)
2	j(1,2)	j(2,2)	j(3,2)	j(4,2)	
3	j(1,3)	j(2,3)	j(3,3)	j(4,3)	
..	..	..	..	..	
J	j(1,J)	j(2,J)	j(3,J)	j(4,J)	
..	..	..	..	..	
ne	j(1,ne)	j(2,ne)	j(3,ne)	j(4,ne)	

np :	total number of nodes
ne :	total number of panels
x(I) :	nodal x-coordinates relative to midships (m)
y(I) :	nodal y-coordinates relative to centerline (m)
z(I) :	nodal z-coordinates relative to calm waterline (m)

j(I,J) : connectivity information, providing four nodal indices on each panel. The nodes are arranged as shown in Figure 2. J is the panel index

As an example, **s60c08.panel** for Series 60 $C_B = 0.8$ is given in Appendix III. The detailed panelization scheme for Series 60 $C_B = 0.8$ is shown in Figure 3 and Figure 4.

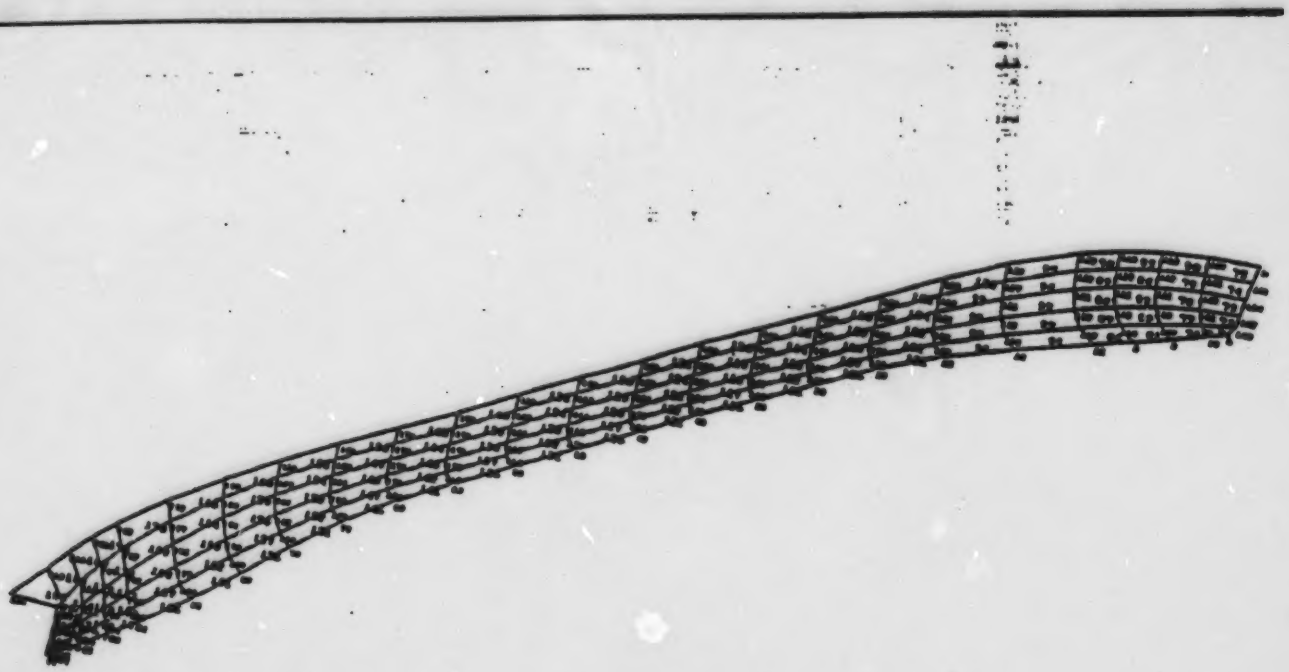

Figure 3: Port Surface Panels Seen from Inside the Ship

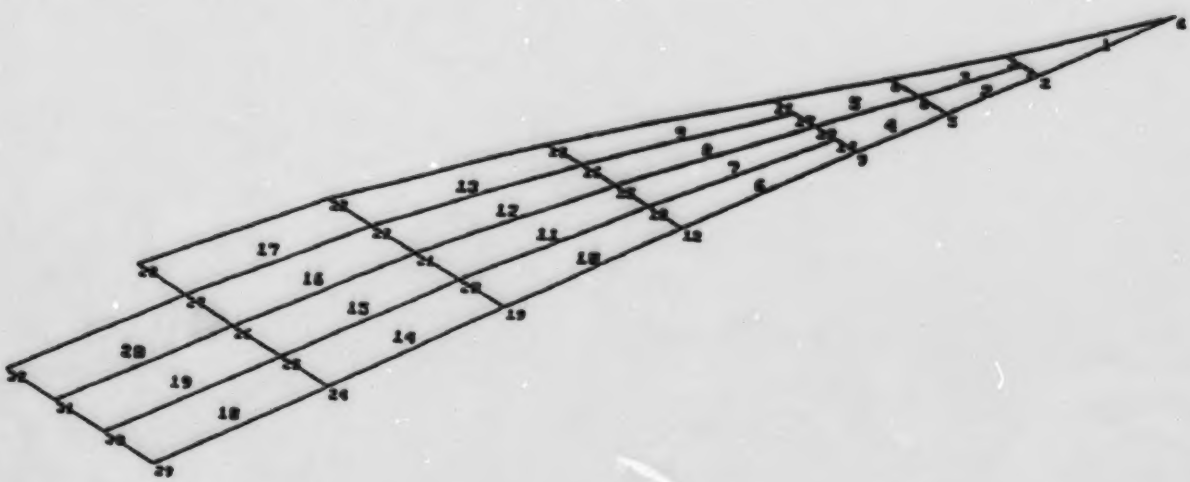

Figure 4: Bottom Panels

2.4 Format of <filename>.damp

The input data file <filename>.damp provides all the necessary data to compute the bilge keel, eddy-making, friction, lifting and appendage damping coefficients, whenever available, and also the resultant viscous damping coefficient.

The format of this file is as follows:

Record(a), Control Parameters

IBK, *IBE*, *IBF*, *IBA*, *IBL* (5 integers)

IBK: if $IBK = 1$, the bilge keel viscous roll damping coefficient is computed; if $IBK = 0$, the bilge keel viscous roll damping coefficient is not computed.

IBE: if $IBE = 1$, the eddy-making viscous roll damping coefficient is computed; if $IBE = 0$, the eddy-making viscous roll damping coefficient is not computed.

IBF: if $IBF = 1$, the friction viscous roll damping coefficient is computed; if $IBF = 0$, the friction viscous roll damping coefficient is not computed.

IBA: if $IBA = 1$, the appendage (other than bilge keel) viscous roll damping coefficient is computed; if $IBA = 0$, the appendage (other than bilge keel) viscous roll damping coefficient is not computed.

IBL: if $IBL = 1$, the lifting viscous roll damping coefficient of rudder and skeg is computed; if $IBL = 0$, the lifting viscous roll damping coefficient of rudder and skeg is not computed.

Record(b), Bilge Keel Longitudinal Location

ns, *ns*0, *ns*1 (3 integers)

ns : total number of sections.
*ns*0 : index of the section where the bilge keel starts.
*ns*1 : index of the section where the bilge keel ends.

Record(c), Water Properties

rho, *mu* (2 real numbers)

rho : density of water (kg/m^3).
mu : kinematic viscosity of water (m^2/s).

Record(d), Bilge Keel Information

b_k, *bk_l* (2 real numbers)

b_k: bilge keel breadth (m).
bk_l: bilge breadth-length ratio.

Record(e1), Sectional Parameters

For sections $i = 1$ to *ns*:

Ship_I(*i*), *Ship_S*(*i*), *Ship_B*(*i*), *Ship_KG*(*i*), *Ship_d*(*i*) (5 real numbers for each section)

Ship_I(*i*) the sectional shape identifier.

for V or U-shaped section, $Ship_I = 1$.
for full-almost rectangular section $Ship_I = 2$.
for triangular section. $Ship_I = 3$.

$Ship_S(i)$	wetted surface area at section i (m^2) (Figure 5).
$Ship_B(i)$	sectional beam (m).
$Ship_KG(i)$	height of ship's C.G. above the lowest point at each section (m).
$Ship_d(i)$	sectional draught (m).

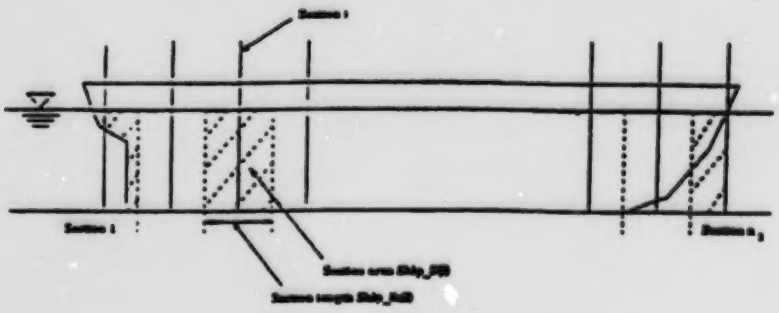

Figure 5: Sectional Length and Area

Record(e2), Sectional Parameters

For sections $i = 1$ to ns:

$Ship_rhat(i), Ship_a(i), Ship_r(i), Ship_rb(i), Ship_lk(i)$ (5 real numbers)

$Ship_rhat(i)$	distance from ship's C.G. to the point where eddies are shed, in the yz plane (m).
$Ship_a(i)$	the inclination angle of ship side at the section waterline (deg) (Figure 6).
$Ship_r(i)$	distance from C.G. to the center of the bilge keel at each section (m); if no bilge keel, set value to zero.
$Ship_rb(i)$	section bilge radius (m) (Figure 6).
$Ship_lk(i)$	section length (m) (Figure 5).

Record(e3), Sectional Parameters

For sections $i = 1$ to ns:

$Ship_G(i), Ship_ss(i), Ship_F_r(i), Ship_a_g(i)$ (4 real numbers)

$Ship_G(i)$	angle between waterlines, from the centre of gravity to the bilge keel root and DWL (rad) (Figure 7).
$Ship_ss(i)$	length of girth from the bilge keel root to DWL (m) (Figure 7).
$Ship_F_r(i)$	sectional deadrise (m) (Figure 6).
$Ship_a_g(i)$	the angle made by the plane of the bilge keel with the straight line passing through C.G. and the bilge keel root (rad) (Figure 7).

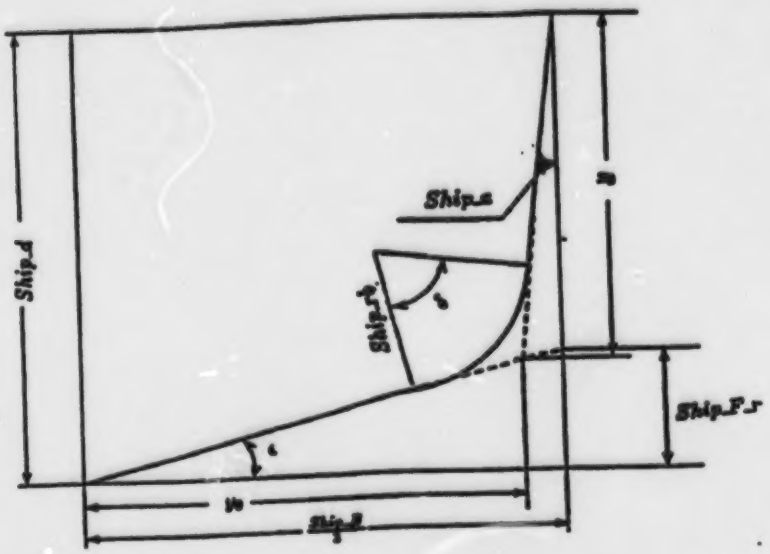

Figure 6: Sectional Parameters

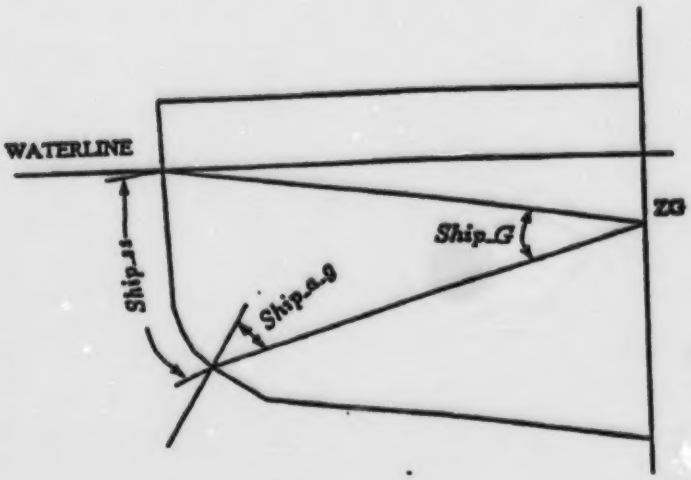

Figure 7: Bilge Keel Parameters

Record(f), Rudder and Deadwood Parameters

b_s, *h_CG*, *b_R*, *sigma*, *S_R* (5 real numbers)

b_s	skeg span (m) (Figure 8).
h_CG	vertical distance of C.G. above waterline (m) (Figure 8).
b_R	rudder span (m) (Figure 8).
sigma	skeg angular parameter (rad) (Figure 8).
S_R	rudder area of single side (m^2).

Record(g1), Parameters of Appendages other than Bilge Keel

na, c_n	(1 integer, 1 real number)
na	total number of appendages.
c_n	normal force coefficient for a flat plate inclined at a large angle to the flow.

Record(g2), Parameters of Appendages other than Bilge Keel

For appendage $i = 1$ to *na*:

App_y(i), *App_z*(i), *App_G*(i), *App_C_e*(i), *App_C_r*(i), *App_Bar_B*(i) (6 real numbers)

App_y(i)	y-coordinate of root of appendage i (m) (Figure 9).

App_z(i) z-coordinate of root of appendage i (m) (Figure 9).

App_G(i) appendage dihedral angle (deg) (Figure 9)

App_C_e(i) end chord of appendage i (m) (Figure 10).

App_C_r(i) root chord of appendage i (m) (Figure 10).

App_Bar_B(i) span of appendage i (m) (Figure 10).

As an example, **s60c08.damp** for Series 60, $C_B = 0.8$ is given in Appendix IV.

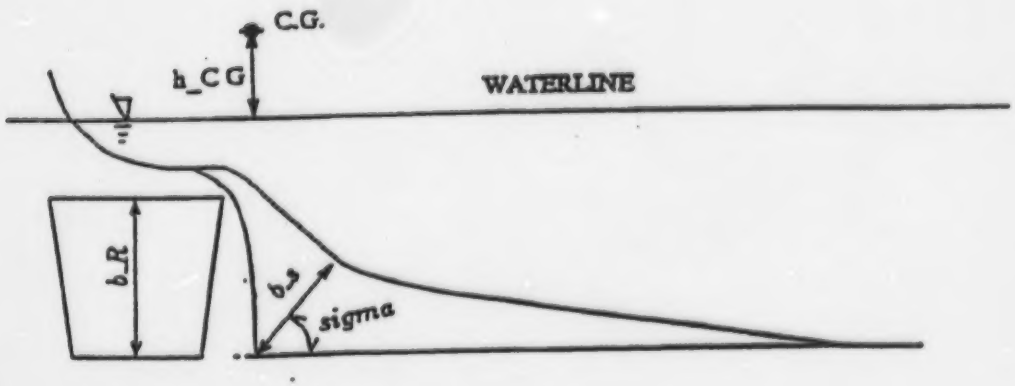

Figure 8: Skeg and Rudder Parameters

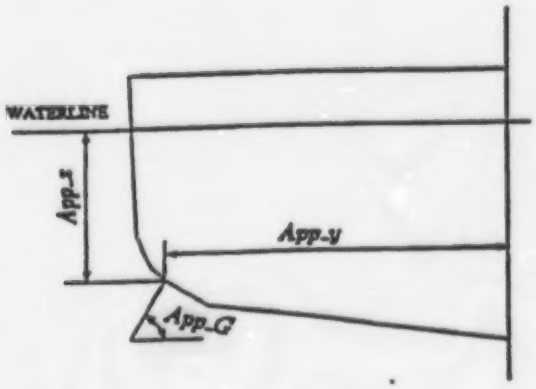

Figure 9: Appendage Parameters

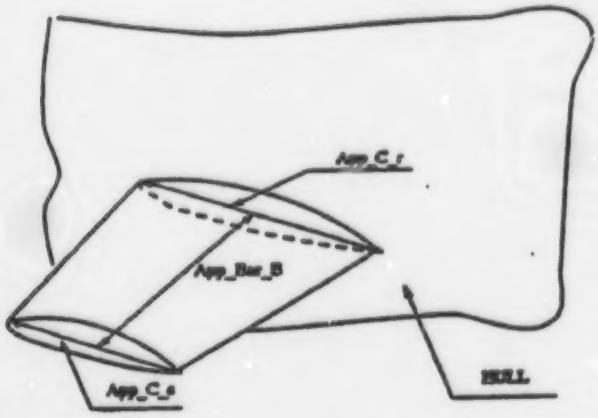

Figure 10: Appendage Parameter Example

3 Part III - Output Data File Description

3.1 Introduction

There are three output files as follows:

<filename>.out	contains the panel information, added mass, damping coefficient, wave exciting force, motion, phase angle and sea loads.
<filename>.chk	contains the steady flow potential and m-terms. This file can be used to check the panelization.
<filename>.pre	contains the pressure on the centroid of each panel.

The nondimensionlization is described in the following section.

3.2 Nondimensionalizations

The non-dimensionalized output data are as follows:

For added masses:

$$\bar{A}_{jj} = A_{jj}/\rho V, \quad (j = 1,\ 2,\ 3)$$
$$\bar{A}_{jj} = A_{jj}/\rho V L^2, \quad (j = 4,\ 5,\ 6)$$

For damping coefficients:

$$\bar{B}_{jj} = B_{jj}/\rho V\sqrt{g/L}, \quad (j = 1,\ 2,\ 3)$$
$$\bar{B}_{jj} = B_{jj}/\rho V L^2\sqrt{g/L}, \quad (j = 4,\ 5,\ 6)$$

For wave exciting forces:

$$\bar{f}_j = |f_j|/\rho g\zeta_a LB, \quad (j = 1,\ 2,\ 3)$$
$$\bar{f}_j = |f_j|/\rho g\zeta_a L^2 B, \quad (j = 4,\ 5,\ 6)$$

For ship motions:

$$\bar{\zeta}_j = |\bar{\xi}_j|/\zeta_a \quad (j = 1,\ 2,\ 3)$$
$$\bar{\zeta}_j = |\bar{\xi}_j|/\zeta_a K \quad (j = 4,\ 5,\ 6)$$

For pressure:

$$\bar{p} = p/\rho g\zeta_a$$

For sea loads:

vertical shear force : $\bar{f}_3^{sld} = |\bar{f}_3^{sld}|/\rho g\zeta_a BL$

vertical bending moment : $\bar{f}_5^{sld} = |\bar{f}_5^{sld}|/\rho g\zeta_a BL^2$

horizontal shear force : $\bar{f}_2^{sld} = |\bar{f}_2^{sld}|/\rho g\zeta_a BL$

horizontal bending moment : $\bar{f}_6^{sld} = |\bar{f}_6^{sld}|/\rho g\zeta_a BL^2$

torsional moment : $\bar{f}_4^{sld} = |\bar{f}_4^{sld}|/\rho g\zeta_a BL^2$

(torque about the longitudinal axis)

For nondimensionalization, the following parameters are used:

L :	ship length between perpendiculars (m)
B :	ship beam (m)
V :	ship volume displacement (m^3)
ρ :	water density (kg/m^3)
g :	gravitational acceleration (m/s^2)
ζ_a :	incident wave amplitude (m)
A_{jj} :	added masses, $(j = 1, 2, \cdots, 6)$
B_{jj} :	damping coefficients, $(j = 1, 2, \cdots, 6)$
$\|f_j\|$:	wave exciting forces, $(j = 1, 2, \cdots, 6)$
$\bar{\xi}_j$:	motion amplitude
$k = \omega^2/g$:	wave number
p:	pressure amplitude on the centroid of each panel
$\|f_j^{sld}\|$:	amplitudes of sea loads $(j = 1, 2, \cdots, 6)$

3.3 Format of <filename>.out

The format of <filename>.out is as follows:

Record (a), General Specifications from Input

SNAME (50) :	name of the ship
Date(25) :	date of computation
NP :	total number of nodal points
NE :	total number of panels
NWL :	total number of wave-length to ship-length ratios
HEADI :	wave heading (deg)
FN :	Froude number
C_b :	block coefficient
L_{bp} :	length between perpendiculars (m)
B :	beam (m)
T :	mean draft (m)
VOL :	volume displacement (m^3)
R_{44} :	radius of gyration of roll (m)
R_{55} :	radius of gyration of pitch (m)
R_{66} :	radius of gyration of yaw (m)
(x_g, y_g, z_g) :	coordinates of the centre of gravity of the ship (m)
$wavefq(i)$:	wave frequencies (rad/sec)

Record (b), Indicies of Panels Adjacent to Waterline

n(1), n(2), ...

Record (c), Nodal Index and Nodal Coordinate

No. :	(1 integer) nodal index

(x_i, y_i, z_i) : (3 real numbers) nodal coordinates (m)

Record (d), Panel Index and Four Nodal Indices

No. : (1 integer) panel index

No1,No2,No3,No4 : (4 integers) connectivity information,four nodal indices on the panel

Record (e), Nondimensional Hydrodynamic Coefficients

No. : (1 integer) index of the wave frequency

LAMDA/L : (1 real number) wave-length to ship-length ratio

W*SQRT(L/g) : (1 real number) $\omega\sqrt{L_{bp}/g}$

PERIODS : (1 real number) wave period (sec)

A_{jj} : (6 real numbers, $j = 1, 2, \cdots, 6$) nondimensional added masses

B_{jj} : (6 real numbers, $j = 1, 2, \cdots, 6$) nondimensional damping coefficients

Record (f), Nondimensional Wave Exciting Forces

No. : nondimensional wave exciting forces

LAMDA/L : (1 real number) wave-length to ship-length ratio

W*SQRT(L/g) : (1 real number) $\omega\sqrt{L_{bp}/g}$

PERIODS : (1 real number) wave period (sec)

F_j : (6 real numbers, $j = 1, 2, \cdots, 6$) the nondimensional exciting force

Record(g), Nondimensional Transfer Function of Motions

LAMDA/L :	(1 real number) wave-length to ship-length ratio
W*SQRT(L/g) :	(1 real number) $\omega\sqrt{L_{bp}/g}$
PERIODS :	(1 real number) wave period (sec)
Y_j/A :	(3 real,$j = 1,2,3$) nondimensional amplitudes of surge, sway and heave;
Y_j/KA :	(3 real,$j = 4,5,6$) nondimensional amplitudes of roll,pitch and yaw
EPj :	(6 real numbers, $j = 1,2,\cdots,6$) phase lags for ship motions in six-degrees-of-freedom (deg).

Record (h), Nondimensional Sea Loads

No. :	(1 integer) index of the wave frequency
LAMDA/L :	(1 real number) wave-length to ship-length ratio
W*SQRT(L/g) :	(1 real number) $\omega\sqrt{L_{bp}/g}$
PERIODS :	(1 real number) wave period (sec)
shfv-3 :	(1 real number) nondimensional vertical shear force
bemv-5 :	(1 real number) nondimensional vertical bending moment
shfh-2 :	(1 real number) nondimensional horizontal shear force
bemh-6 :	(1 real number) nondimensional horizontal bending moment
bemt-4 :	(1 real number) nondimensional torsional moment (torque about the longitudinal axis)

As an example, **s60c08.out** for Series 60, $C_B = 0.8$ is given in Appendix V.

3.4 Format of <filename>.chk

Output file <filename>.chk has the following format:

Record(a), Centroidal Coordinates and Areas of panels

i, xc(i), yc(i), zc(i), area(i) (1 integer, 4 real numbers)

Record(b), Normals in Six Modes

i, un(1,i), un(2,i), un(3,i), un(4,i), un(5,i), un(6,i) (1 integer, 6 real numbers)

Record-2, Steady Flow Potential Functions and Its Gradients

i, $\phi_s(i)$, $V_{sx}(i)$, $V_{sy}(i)$, $V_{sz}(i)$ (1 integer, 4 real numbers)

Record(c), m-terms

i, um(1,i), um(2,i), um(3,i), um(4,i), um(5,i), um(6,i) (1 integer, 6 real numbers)

In the above records:

xc(i) :	x-coordinate of centroid on panels, $i = 1, 2, \cdots, ne$
yc(i) :	y-coordinate of centroid on panels, $i = 1, 2, \cdots, ne$
zc(i) :	z-coordinate of centroid on panels, $i = 1, 2, \cdots, ne$
area(i) :	area of panels, $i = 1, 2, \cdots, ne$
un(k, i) :	generalized normal on panels, $k = 1, 2, \cdots, 6$; $i = 1, 2, \cdots, ne$
$\phi_s(i)$:	steady disturbance potential on panels, $i = 1, 2, \cdots, ne$
$V_{sx}(i)$:	x-component of steady disturbance velocity on panels, $i = 1, 2, \cdots, ne$
$V_{sy}(i)$:	y-component of steady disturbance velocity on panels, $i = 1, 2, \cdots, ne$
$V_{sz}(i)$:	z-component of steady disturbance velocity on panels, $i = 1, 2, \cdots, ne$

um(k,i) : m-terms on panels, $k = 1, 2, \cdots, 6$; $i = 1, 2, \cdots, ne$
where ne is the total number of panels.

As an example, **s60c08.chk** for Series 60, $C_B = 0.8$ is given in Appendix VI.

3.5 Format of <filename>.pre

Output file <filename>.pre contains the pressure on the centroid of each panel on the port and starboard.

The file format is shown as follows:

Record(a), The direction and frequency of incident waves

Heading and Frequency (2 real numbers)

Record(b), The pressure on the centre of gravity of each panel

i, xc(i), yc(i), zc(i), p(i), phase(i) (1 integer, 5 real numbers)

In the above records:

xc(i) :	x-coordinate of centroid on panels, $i = 1, 2ne$
yc(i) :	y-coordinate of centroid on panels, $i = 1, 2ne$
zc(i) :	z-coordinate of centroid on panels, $i = 1, 2ne$
p(i) :	nondimensional pressure on centroid of panel, $i = 1, 2ne$
phase(i) :	phase angle of pressure on centroid of panel, $i = 1, 2ne$, (deg)

As an example, **s60c08.pre** for Series 60, $C_B = 0.8$ is given in Appendix VII.

References

[1] Hsiung,C.C., and Huang, Z.J., "Final Report - The Frequency-Domain Prediction of Added Resistance of Ships in Waves Using a Near-Field, 3-Dimensional Flow Method", DREA Contractor Report CR/95/484, 27 October 1995.

[2] Hsiung, C.C., and Huang, Z.J., "User's Manual for SMCA4", DREA Contractor Report CR/95/485, 1995.

[3] Hsiung, C.C., He, Y.J. and Lu, X.G., "User's Guide for an Automatic Panelization Program, PANELGEN", DREA Contractor Report CR/96/419, 1996.

Appendix I. Definitions of the Coordinate System and Ship Motions

A steady moving coordinate system $oxyz$ and the definition of ship motions in six-degrees-of-freedom are shown in Figure I-1.

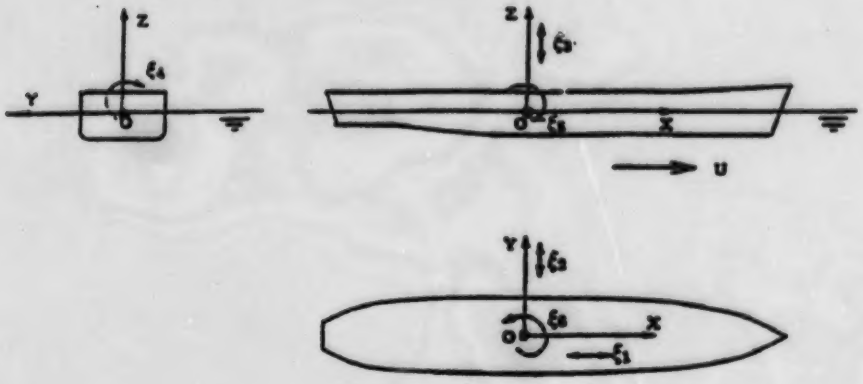

Figure I-1: Coordinate System and Ship Motions

This coordinate system moves at a steady forward speed U in the x-direction. The origin is located amidships on the calm water surface. The xoy plane coincides with the calm water surface and the yoz plane is located amidships. oz is vertical upward and oy points toward the port side of the ship. In Figure I-1, ξ_1, ξ_2, ξ_3, ξ_4, ξ_5 and ξ_6 are motions of surge, sway, heave, roll, pitch and yaw, respectively. The wave propagation direction is shown in Figure I-2. where the wave heading, β, is the angle between the wave propagation direction and the x-axis.

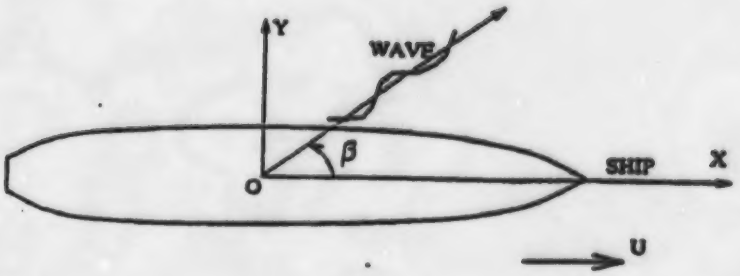

Figure I-2: Direction of the Incident Wave Propagation

Appendix II The s60c08.ctrl File

```
'Series 60 Cb=0.8'
'June 15, 1998'
1 1 1 1
124.  17.71  7.08  12438.37  3.1  0.  -1.17  0.15 0.80
5.755  29.76  35.4 0.558 0.120 0.180 0.325  0.
1.
1
170.
1
0.5
```

Appendix III The s60c08.panel File

```
224 190
1 60.450001 0.000000 -7.085714
2 55.799999 0.000000 -7.085714
3 55.799999 1.204571 -7.085714
4 60.450001 0.015057 -7.085714
5 52.700001 0.000000 -7.085714
6 52.700001 1.076586 -7.085714
7 55.799999 0.602286 -7.085714
8 52.700001 2.153172 -7.085714
9 49.599998 0.000000 -7.085714
10 49.599998 1.596057 -7.085714
11 49.599998 3.184586 -7.085714
12 43.400002 0.000000 -7.085714
13 43.400002 1.309971 -7.085714
14 49.599998 0.798029 -7.085714
15 43.400002 2.619943 -7.085714
16 43.400002 3.929914 -7.085714
17 49.599998 2.394086 -7.085714
18 43.400002 5.239886 -7.085714
19 37.200001 0.000000 -7.085714
20 37.200001 1.701457 -7.085714
21 37.200001 3.402914 -7.085714
22 37.200001 5.104371 -7.085714
23 37.200001 6.798300 -7.085714
24 31.000000 0.000000 -7.085714
25 31.000000 1.863322 -7.085714
26 31.000000 3.726643 -7.085714
27 31.000000 5.589964 -7.085714
28 31.000000 7.453286 -7.085714
29 24.799999 0.000000 -7.085714
30 24.799999 1.882143 -7.085714
31 24.799999 3.764286 -7.085714
32 24.799999 5.646429 -7.085714
33 24.799999 7.528572 -7.085714
34 18.599998 0.000000 -7.085714
35 18.599998 1.882143 -7.085714
36 18.599998 3.764286 -7.085714
37 18.599998 5.646429 -7.085714
38 18.599998 7.528572 -7.085714
39 12.400002 0.000000 -7.085714
40 12.400002 1.882143 -7.085714
41 12.400002 3.764286 -7.085714
42 12.400002 5.646429 -7.085714
43 12.400002 7.528572 -7.085714
44 6.200001 0.000000 -7.085714
45 6.200001 1.882143 -7.085714
46 6.200001 3.764286 -7.085714
```

```
47 6.200001 5.646429 -7.085714
48 6.200001 7.528572 -7.085714
49 0.000000 0.000000 -7.085714
50 0.000000 1.882143 -7.085714
51 0.000000 3.764286 -7.085714
52 0.000000 5.646429 -7.085714
53 0.000000 7.528572 -7.085714
54 -6.199997 0.000000 -7.085714
55 -6.199997 1.882143 -7.085714
56 -6.199997 3.764286 -7.085714
57 -6.199997 5.646429 -7.085714
58 -6.199997 7.528572 -7.085714
59 -12.400002 0.000000 -7.085714
60 -12.400002 1.874614 -7.085714
61 -12.400002 3.749229 -7.085714
62 -12.400002 5.623843 -7.085714
63 -12.400002 7.498457 -7.085714
64 -18.599998 0.000000 -7.085714
65 -18.599998 1.803093 -7.085714
66 -18.599998 3.606186 -7.085714
67 -18.599998 5.409278 -7.085714
68 -18.599998 7.212372 -7.085714
69 -24.800003 0.000000 -7.085714
70 -24.800003 1.614879 -7.085714
71 -24.800003 3.229757 -7.085714
72 -24.800003 4.844635 -7.085714
73 -24.800003 6.459514 -7.085714
74 -31.000000 0.000000 -7.085714
75 -31.000000 1.291150 -7.085714
76 -31.000000 2.582300 -7.085714
77 -31.000000 3.873450 -7.085714
78 -31.000000 5.164600 -7.085714
79 -37.199997 0.000000 -7.085714
80 -37.199997 0.914721 -7.085714
81 -37.199997 1.829443 -7.085714
82 -37.199997 2.744164 -7.085714
83 -37.199997 3.658886 -7.085714
84 -43.400002 0.000000 -7.085714
85 -43.400002 0.568407 -7.085714
86 -43.400002 1.136814 -7.085714
87 -43.400002 1.705221 -7.085714
88 -43.400002 2.273628 -7.085714
89 -49.599998 0.000000 -7.085714
90 -49.599998 0.549586 -7.085714
91 -49.599998 1.099171 -7.085714
92 -52.699997 0.000000 -7.085714
93 -52.699997 0.692629 -7.085714
94 -55.800003 0.000000 -7.085714
95 -55.800003 0.338786 -7.085714
96 -59.625000 0.000000 -7.085714
97 -59.625000 0.015057 -7.085714
98 58.900002 0.399014 -7.085714
99 58.900002 1.391811 -6.554286
```

100	61.265999	0.000000	-6.554286
101	58.900002	2.081429	-5.314286
102	61.388000	0.000000	-5.314286
103	58.900002	2.285143	-3.542857
104	61.511002	0.000000	-3.542857
105	58.900002	2.364857	-1.771429
106	61.731998	0.000000	-1.771429
107	58.900002	2.533143	0.000000
108	62.000000	0.000000	0.000000
109	55.799999	2.783623	-6.554286
110	55.799999	3.852857	-5.314286
111	55.799999	4.304572	-3.542857
112	55.799999	4.472857	-1.771429
113	55.799999	4.623429	0.000000
114	52.700001	4.012197	-6.554286
115	52.700001	5.146000	-5.314286
116	52.700001	5.757143	-3.542857
117	52.700001	6.031714	-1.771429
118	52.700001	6.200000	0.000000
119	49.599998	5.077535	-6.554286
120	49.599998	6.217714	-5.314286
121	49.599998	6.855429	-3.542857
122	49.599998	7.156572	-1.771429
123	49.599998	7.351429	0.000000
124	43.400002	6.813003	-6.554286
125	43.400002	7.679143	-5.314286
126	43.400002	8.157429	-3.542857
127	43.400002	8.396571	-1.771429
128	43.400002	8.538285	0.000000
129	37.200001	7.981438	-6.554286
130	37.200001	8.520572	-5.314286
131	37.200001	8.706572	-3.542857
132	37.200001	8.804000	-1.771429
133	37.200001	8.848286	0.000000
134	31.000000	8.514106	-6.554286
135	31.000000	8.812858	-5.314286
136	31.000000	8.839429	-3.542857
137	31.000000	8.857142	-1.771429
138	31.000000	8.857142	0.000000
139	24.799999	8.591429	-6.554286
140	24.799999	8.857142	-5.314286
141	24.799999	8.857142	-3.542857
142	24.799999	8.857142	-1.771429
143	24.799999	8.857142	0.000000
144	18.599998	8.591429	-6.554286
145	18.599998	8.857142	-5.314286
146	18.599998	8.857142	-3.542857
147	18.599998	8.857142	-1.771429
148	18.599998	8.857142	0.000000
149	12.400002	8.591429	-6.554286
150	12.400002	8.857142	-5.314286
151	12.400002	8.857142	-3.542857
152	12.400002	8.857142	-1.771429

```
153 12.400002 8.857142 0.000000
154 6.200001 8.591429 -6.554286
155 6.200001 8.857142 -5.314286
156 6.200001 8.857142 -3.542857
157 6.200001 8.857142 -1.771429
158 6.200001 8.857142 0.000000
159 0.000000 8.591429 -6.554286
160 0.000000 8.857142 -5.314286
161 0.000000 8.857142 -3.542857
162 0.000000 8.857142 -1.771429
163 0.000000 8.857142 0.000000
164 -6.199997 8.591429 -6.554286
165 -6.199997 8.857142 -5.314286
166 -6.199997 8.857142 -3.542857
167 -6.199997 8.857142 -1.771429
168 -6.199997 8.857142 0.000000
169 -12.400002 8.565655 -6.554286
170 -12.400002 8.857142 -5.314286
171 -12.400002 8.857142 -3.542857
172 -12.400002 8.857142 -1.771429
173 -12.400002 8.857142 0.000000
174 -18.599998 8.385235 -6.554286
175 -18.599998 8.821714 -5.314286
176 -18.599998 8.857142 -3.542857
177 -18.599998 8.857142 -1.771429
178 -18.599998 8.857142 0.000000
179 -24.800003 7.783834 -6.554286
180 -24.800003 8.485143 -5.314286
181 -24.800003 8.777429 -3.542857
182 -24.800003 8.857142 -1.771429
183 -24.800003 8.857142 0.000000
184 -31.000000 6.701314 -6.554286
185 -31.000000 7.723428 -5.314286
186 -31.000000 8.334571 -3.542857
187 -31.000000 8.609143 -1.771429
188 -31.000000 8.750857 0.000000
189 -37.199997 5.369643 -6.554286
190 -37.199997 6.430286 -5.314286
191 -37.199997 7.360285 -3.542857
192 -37.199997 7.971428 -1.771429
193 -37.199997 8.334571 0.000000
194 -43.400002 3.797411 -6.554286
195 -43.400002 4.800571 -5.314286
196 -43.400002 5.810286 -3.542857
197 -43.400002 6.775714 -1.771429
198 -43.400002 7.537429 0.000000
199 -49.599998 2.285320 -6.554286
200 -49.599998 2.984857 -5.314286
201 -49.599998 3.782000 -3.542857
202 -49.599998 4.960000 -1.771429
203 -49.599998 6.306286 0.000000
204 -52.699997 1.589414 -6.554286
205 -52.699997 2.054857 -5.314286
```

```
206 -52.699997 2.639429 -3.542857
207 -52.699997 3.764286 -1.771429
208 -52.699997 5.464857 0.000000
209 -55.800003 0.902100 -6.554286
210 -55.800003 1.151429 -5.314286
211 -55.800003 1.470286 -3.542857
212 -55.800003 2.329429 -1.771429
213 -55.800003 4.455143 0.000000
214 -58.900002 0.097871 -7.085714
215 -58.900002 0.223377 -6.554286
216 -58.900002 0.283429 -5.314286
217 -58.900002 0.310000 -3.542857
218 -58.900002 0.628857 -1.771429
219 -58.900002 3.126571 0.000000
220 -59.625000 0.000000 -6.554286
221 -59.625000 0.000000 -5.314286
222 -59.625000 0.000000 -3.542857
223 -59.865597 0.000000 -1.771429
224 -64.089996 1.417143 0.000000
1 4 3 2 1
2 7 6 5 2
3 3 8 6 7
4 6 10 9 5
5 8 11 10 6
6 14 13 12 9
7 10 15 13 14
8 17 16 15 10
9 11 18 16 17
10 13 20 19 12
11 15 21 20 13
12 16 22 21 15
13 18 23 22 16
14 20 25 24 19
15 21 26 25 20
16 22 27 26 21
17 23 28 27 22
18 25 30 29 24
19 26 31 30 25
20 27 32 31 26
21 28 33 32 27
22 30 35 34 29
23 31 36 35 30
24 32 37 36 31
25 33 38 37 32
26 35 40 39 34
27 36 41 40 35
28 37 42 41 36
29 38 43 42 37
30 40 45 44 39
31 41 46 45 40
32 42 47 46 41
33 43 48 47 42
34 45 50 49 44
```

```
35 46 51 50 45
36 47 52 51 46
37 48 53 52 47
38 50 55 54 49
39 51 56 55 50
40 52 57 56 51
41 53 58 57 52
42 55 60 59 54
43 56 61 60 55
44 57 62 61 56
45 58 63 62 57
46 60 65 64 59
47 61 66 65 60
48 62 67 66 61
49 63 68 67 62
50 65 70 69 64
51 66 71 70 65
52 67 72 71 66
53 68 73 72 67
54 70 75 74 69
55 71 76 75 70
56 72 77 76 71
57 73 78 77 72
58 75 80 79 74
59 76 81 80 75
60 77 82 81 76
61 78 83 82 77
62 80 85 84 79
63 81 86 85 80
64 82 87 86 81
65 83 88 87 82
66 86 90 89 84
67 88 91 90 86
68 91 93 92 89
69 93 95 94 92
70 95 97 96 94
71 100 99 98 4
72 102 101 99 100
73 104 103 101 102
74 106 105 103 104
75 108 107 105 106
76 99 109 3 98
77 101 110 109 99
78 103 111 110 101
79 105 112 111 103
80 107 113 112 105
81 109 114 8 3
82 110 115 114 109
83 111 116 115 110
84 112 117 116 111
85 113 118 117 112
86 114 119 11 8
87 115 120 119 114
```

88 116 121 120 115
89 117 122 121 116
90 118 123 122 117
91 119 124 18 11
92 120 125 124 119
93 121 126 125 120
94 122 127 126 121
95 123 128 127 122
96 124 129 23 18
97 125 130 129 124
98 126 131 130 125
99 127 132 131 126
100 128 133 132 127
101 129 134 28 23
102 130 135 134 129
103 131 136 135 130
104 132 137 136 131
105 133 138 137 132
106 134 139 33 28
107 135 140 139 134
108 136 141 140 135
109 137 142 141 136
110 138 143 142 137
111 139 144 38 33
112 140 145 144 139
113 141 146 145 140
114 142 147 146 141
115 143 148 147 142
116 144 149 43 38
117 145 150 149 144
118 146 151 150 145
119 147 152 151 146
120 148 153 152 147
121 149 154 48 43
122 150 155 154 149
123 151 156 155 150
124 152 157 156 151
125 153 158 157 152
126 154 159 53 48
127 155 160 159 154
128 156 161 160 155
129 157 162 161 156
130 158 163 162 157
131 159 164 58 53
132 160 165 164 159
133 161 166 165 160
134 162 167 166 161
135 163 168 167 162
136 164 169 63 58
137 165 170 169 164
138 166 171 170 165
139 167 172 171 166
140 168 173 172 167

```
141 169 174 68 63
142 170 175 174 169
143 171 176 175 170
144 172 177 176 171
145 173 178 177 172
146 174 179 73 68
147 175 180 179 174
148 176 181 180 175
149 177 182 181 176
150 178 183 182 177
151 179 184 78 73
152 180 185 184 179
153 181 186 185 180
154 182 187 186 181
155 183 188 187 182
156 184 189 83 78
157 185 190 189 184
158 186 191 190 185
159 187 192 191 186
160 188 193 192 187
161 189 194 88 83
162 190 195 194 189
163 191 196 195 190
164 192 197 196 191
165 193 198 197 192
166 194 199 91 88
167 195 200 199 194
168 196 201 200 195
169 197 202 201 196
170 198 203 202 197
171 199 204 93 91
172 200 205 204 199
173 201 206 205 200
174 202 207 206 201
175 203 208 207 202
176 204 209 95 93
177 205 210 209 204
178 206 211 210 205
179 207 212 211 206
180 208 213 212 207
181 209 215 214 95
182 210 216 215 209
183 211 217 216 210
184 212 218 217 211
185 213 219 218 212
186 215 220 97 214
187 216 221 220 215
188 217 222 221 216
189 218 223 222 217
190 219 224 223 218
```

Appendix IV The s60c08.damp File

```
 1 1 1 0 1
 25 9 17
 999.099976  1.13999999E-06
 .495999992  .0100000007
3  0.  0.  0.  0.
3  48.7886086  1.30888879  7.0817771  7.0817771
1  50.6561127  2.47999978  7.0817771  7.0817771
1  52.9904938  3.99555516  7.0817771  7.0817771
1  85.0882721  5.64888859  7.0817771  7.0817771
1  129.324829  9.02444363  7.0817771  7.0817771
1  145.198624  12.1933327  7.0817771  7.0817771
2  162.473068  14.6733322  7.0817771  7.0817771
2  176.012482  16.3955555  7.0817771  7.0817771
2  186.283752  17.2222214  7.0817771  7.0817771
2  194.220673  17.4288883  7.0817771  7.0817771
2  203.091339  17.704443  7.0817771  7.0817771
2  203.091339  17.704443  7.0817771  7.0817771
2  203.091339  17.704443  7.0817771  7.0817771
2  201.690704  17.704443  7.0817771  7.0817771
2  194.220673  17.704443  7.0817771  7.0817771
2  187.684402  17.4977779  7.0817771  7.0817771
1  180.214371  16.9466667  7.0817771  7.0817771
1  162.473068  15.7755547  7.0817771  7.0817771
1  145.198624  13.8466663  7.0817771  7.0817771
1  98.0440903  11.2977772  7.0817771  7.0817771
3  61.6277122  9.50666618  7.0817771  7.0817771
3  57.425827  7.57777739  7.0817771  7.0817771
3  53.690815  5.44222212  7.0817771  7.0817771
3  4.90220451  2.75555539  .75777775  .75777775
 0.  0.  0.  0.  1.54999995
 7.40411043  0.  0.  0.  3.0999999
 7.40411043  3.5  0.  0.  3.0999999
 7.40411043  5.5  0.  0.  3.0999999
 7.40411043  7.5  0.  0.  4.6500001
 7.40411043  9.  0.  0.  6.19999981
 7.40411043  10.  0.  0.  6.19999981
 7.40411043  6.  0.  0.  6.19999981
 9.14710236  5.  9.86734581  2.66490364  6.19999981
 9.79532242  0.  10.0834198  2.16073275  6.19999981
 10.2274685  0.  10.5155659  1.87263513  6.19999981
 10.5875902  0.  10.9477119  1.7285862  6.19999981
 10.5875902  0.  10.9477119  1.7285862  6.19999981
 10.5875902  0.  10.9477119  1.7285862  6.19999981
 10.4435415  0.  10.8036642  2.16073275  6.19999981
 10.0834198  0.  10.4435415  2.52085495  6.19999981
 9.36317444  2.5  9.86734581  2.9530015  6.19999981
```

```
 7.40411043  6.   0.   0.   6.19999981
 7.40411043  14.   0.   0.   6.19999981
 7.40411043  30.   0.   0.   6.19999981
 7.40411043  38.   0.   0.   4.6500001
 7.40411043  45.   0.   0.   3.0999999
 7.40411043  60.   0.   0.   3.0999999
 7.40411043  65.   0.   0.   3.0999999
 .792268693  70.   0.   0.   1.54999995
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  6.33814955  0.   .104699999
 .680000007  6.59743738  0.   .104699999
 .680000007  7.02238131  0.   .104699999
 .680000007  7.11601353  0.   .104699999
 .680000007  7.11601353  0.   .104699999
 .680000007  7.11601353  0.   .104699999
 .680000007  6.74148607  0.   .104699999
 .680000007  6.59743738  0.   .104699999
 .680000007  6.12927866  0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
 .680000007  0.   0.   .104699999
4.1    0.0      5.33     .9666666          13.27
  0  0.
```

Appendix V The s60c08.out File

```
DATE OF COMPUTATION :June 15, 1998

SHIP FORM :Series 60 Cb=0.8

INPUT DATA:
-----------

SHIP HEADING, FROUDE NO. AND GEOMETRICAL PRINCIPALS:
----------------------------------------------------
NP=224 NE=190 NWL= 1  HEADI=170.0 (Degrees) FN=  .1500 C_B=  .80
Lbp=124.00 (m.) B = 17.71 (m.) T =  7.08 (m.) VOL= 12438.370 (m.**3)
R44=  5.76 (m.) R55= 29.76(m.) R66= 35.40 (m.)
xg=  3.10 (m.) yg=   .00(m.) zg= -1.17 (m.)

WAVE FREQUENCIES:
-----------------
wavefq(i)=    .997

INDICES OF PANELS ADJACENT TO WATERLINE:
----------------------------------------
75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175
180 185 190


NODAL INDEX (No.) AND NODAL COORDINATES (Xi,Yi,Zi)
--------------------------------------------------
No.    Xi       Yi       Zi      No.    Xi       Yi       Zi

 1   60.450     .000   -7.086    2   55.800     .000   -7.086
 3   55.800    1.205   -7.086    4   60.450     .015   -7.086
 5   52.700     .000   -7.086    6   52.700    1.077   -7.086
 7   55.800     .602   -7.086    8   52.700    2.153   -7.086
 9   49.600     .000   -7.086   10   49.600    1.596   -7.086
11   49.600    3.185   -7.086   12   43.400     .000   -7.086
13   43.400    1.310   -7.086   14   49.600     .798   -7.086
15   43.400    2.620   -7.086   16   43.400    3.930   -7.086
17   49.600    2.394   -7.086   18   43.400    5.240   -7.086
19   37.200     .000   -7.086   20   37.200    1.701   -7.086
21   37.200    3.403   -7.086   22   37.200    5.104   -7.086
23   37.200    6.798   -7.086   24   31.000     .000   -7.086
25   31.000    1.863   -7.086   26   31.000    3.727   -7.086
27   31.000    5.590   -7.086   28   31.000    7.453   -7.086
29   24.800     .000   -7.086   30   24.800    1.882   -7.086
31   24.800    3.764   -7.086   32   24.800    5.646   -7.086
```

33	24.800	7.529	-7.086	34	18.600	.000	-7.086
35	18.600	1.882	-7.086	36	18.600	3.764	-7.086
37	18.600	5.646	-7.086	38	18.600	7.529	-7.086
39	12.400	.000	-7.086	40	12.400	1.882	-7.086
41	12.400	3.764	-7.086	42	12.400	5.646	-7.086
43	12.400	7.529	-7.086	44	6.200	.000	-7.086
45	6.200	1.882	-7.086	46	6.200	3.764	-7.086
47	6.200	5.646	-7.086	48	6.200	7.529	-7.086
49	.000	.000	-7.086	50	.000	1.882	-7.086
51	.000	3.764	-7.086	52	.000	5.646	-7.086
53	.000	7.529	-7.086	54	-6.200	.000	-7.086
55	-6.200	1.882	-7.086	56	-6.200	3.764	-7.086
57	-6.200	5.646	-7.086	58	-6.200	7.529	-7.086
59	-12.400	.000	-7.086	60	-12.400	1.875	-7.086
61	-12.400	3.749	-7.086	62	-12.400	5.624	-7.086
63	-12.400	7.498	-7.086	64	-18.600	.000	-7.086
65	-18.600	1.803	-7.086	66	-18.600	3.606	-7.086
67	-18.600	5.409	-7.086	68	-18.600	7.212	-7.086
69	-24.800	.000	-7.086	70	-24.800	1.615	-7.086
71	-24.800	3.230	-7.086	72	-24.800	4.845	-7.086
73	-24.800	6.460	-7.086	74	-31.000	.000	-7.086
75	-31.000	1.291	-7.086	76	-31.000	2.582	-7.086
77	-31.000	3.873	-7.086	78	-31.000	5.165	-7.086
79	-37.200	.000	-7.086	80	-37.200	.915	-7.086
81	-37.200	1.829	-7.086	82	-37.200	2.744	-7.086
83	-37.200	3.659	-7.086	84	-43.400	.000	-7.086
85	-43.400	.568	-7.086	86	-43.400	1.137	-7.086
87	-43.400	1.705	-7.086	88	-43.400	2.274	-7.086
89	-49.600	.000	-7.086	90	-49.600	.550	-7.086
91	-49.600	1.099	-7.086	92	-52.700	.000	-7.086
93	-52.700	.693	-7.086	94	-55.800	.000	-7.086
95	-55.800	.339	-7.086	96	-59.625	.000	-7.086
97	-59.625	.015	-7.086	98	58.900	.399	-7.086
99	58.900	1.392	-6.554	100	61.266	.000	-6.554
101	58.900	2.081	-5.314	102	61.388	.000	-5.314
103	58.900	2.285	-3.543	104	61.511	.000	-3.543
105	58.900	2.365	-1.771	106	61.732	.000	-1.771
107	58.900	2.533	.000	108	62.000	.000	.000
109	55.800	2.784	-6.554	110	55.800	3.853	-5.314
111	55.800	4.305	-3.543	112	55.800	4.473	-1.771
113	55.800	4.623	.000	114	52.700	4.012	-6.554
115	52.700	5.146	-5.314	116	52.700	5.757	-3.543
117	52.700	6.032	-1.771	118	52.700	6.200	.000
119	49.600	5.078	-6.554	120	49.600	6.218	-5.314
121	49.600	6.855	-3.543	122	49.600	7.157	-1.771
123	49.600	7.351	.000	124	43.400	6.813	-6.554
125	43.400	7.679	-5.314	126	43.400	8.157	-3.543
127	43.400	8.397	-1.771	128	43.400	8.538	.000
129	37.200	7.981	-6.554	130	37.200	8.521	-5.314
131	37.200	8.707	-3.543	132	37.200	8.804	-1.771
133	37.200	8.848	.000	134	31.000	8.514	-6.554
135	31.000	8.813	-5.314	136	31.000	8.839	-3.543
137	31.000	8.857	-1.771	138	31.000	8.857	.000

139	24.800	8.591	-6.554	140	24.800	8.857	-5.314
141	24.800	8.857	-3.543	142	24.800	8.857	-1.771
143	24.800	8.857	.000	144	18.600	8.591	-6.554
145	18.600	8.857	-5.314	146	18.600	8.857	-3.543
147	18.600	8.857	-1.771	148	18.600	8.857	.000
149	12.400	8.591	-6.554	150	12.400	8.857	-5.314
151	12.400	8.857	-3.543	152	12.400	8.857	-1.771
153	12.400	8.857	.000	154	6.200	8.591	-6.554
155	6.200	8.857	-5.314	156	6.200	8.857	-3.543
157	6.200	8.857	-1.771	158	6.200	8.857	.000
159	.000	8.591	-6.554	160	.000	8.857	-5.314
161	.000	8.857	-3.543	162	.000	8.857	-1.771
163	.000	8.857	.000	164	-6.200	8.591	-6.554
165	-6.200	8.857	-5.314	166	-6.200	8.857	-3.543
167	-6.200	8.857	-1.771	168	-6.200	8.857	.000
169	-12.400	8.566	-6.554	170	-12.400	8.857	-5.314
171	-12.400	8.857	-3.543	172	-12.400	8.857	-1.771
173	-12.400	8.857	.000	174	-18.600	8.385	-6.554
175	-18.600	8.822	-5.314	176	-18.600	8.857	-3.543
177	-18.600	8.857	-1.771	178	-18.600	8.857	.000
179	-24.800	7.784	-6.554	180	-24.800	8.485	-5.314
181	-24.800	8.777	-3.543	182	-24.800	8.857	-1.771
183	-24.800	8.857	.000	184	-31.000	6.701	-6.554
185	-31.000	7.723	-5.314	186	-31.000	8.335	-3.543
187	-31.000	8.609	-1.771	188	-31.000	8.751	.000
189	-37.200	5.370	-6.554	190	-37.200	6.430	-5.314
191	-37.200	7.360	-3.543	192	-37.200	7.971	-1.771
193	-37.200	8.335	.000	194	-43.400	3.797	-6.554
195	-43.400	4.801	-5.314	196	-43.400	5.810	-3.543
197	-43.400	6.776	-1.771	198	-43.400	7.537	.000
199	-49.600	2.285	-6.554	200	-49.600	2.985	-5.314
201	-49.600	3.782	-3.543	202	-49.600	4.960	-1.771
203	-49.600	6.306	.000	204	-52.700	1.589	-6.554
205	-52.700	2.055	-5.314	206	-52.700	2.639	-3.543
207	-52.700	3.764	-1.771	208	-52.700	5.465	.000
209	-55.800	.902	-6.554	210	-55.800	1.151	-5.314
211	-55.800	1.470	-3.543	212	-55.800	2.329	-1.771
213	-55.800	4.455	.000	214	-58.900	.098	-7.086
215	-58.900	.223	-6.554	216	-58.900	.283	-5.314
217	-58.900	.310	-3.543	218	-58.900	.629	-1.771
219	-58.900	3.127	.000	220	-59.625	.000	-6.554
221	-59.625	.000	-5.314	222	-59.625	.000	-3.543
223	-59.866	.000	-1.771	224	-64.090	1.417	.000

PANEL INDEX (No.) AND FOUR NODAL INDICES (No1,No2,No3,No4)

No.	No1	No2	No3	No4	No.	No1	No2	No3	No4	No.	No1	No2	No3	No4
1	4	3	2	1	2	7	6	5	2	3	3	8	6	7
4	6	10	9	5	5	8	11	10	6	6	14	13	12	9
7	10	15	13	14	8	17	16	15	10	9	11	18	16	17

10	13	20	19	12	11	15	21	20	13	12	16	22	21	15
13	18	23	22	16	14	20	25	24	19	15	21	26	25	20
16	22	27	26	21	17	23	28	27	22	18	25	30	29	24
19	26	31	30	25	20	27	32	31	26	21	28	33	32	27
22	30	35	34	29	23	31	36	35	30	24	32	37	36	31
25	33	38	37	32	26	35	40	39	34	27	36	41	40	35
28	37	42	41	36	29	38	43	42	37	30	40	45	44	39
31	41	46	45	40	32	42	47	46	41	33	43	48	47	42
34	45	50	49	44	35	46	51	50	45	36	47	52	51	46
37	48	53	52	47	38	50	55	54	49	39	51	56	55	50
40	52	57	56	51	41	53	58	57	52	42	55	60	59	54
43	56	61	60	55	44	57	62	61	56	45	58	63	62	57
46	60	65	64	59	47	61	66	65	60	48	62	67	66	61
49	63	68	67	62	50	65	70	69	64	51	66	71	70	65
52	67	72	71	66	53	68	73	72	67	54	70	75	74	69
55	71	76	75	70	56	72	77	76	71	57	73	78	77	72
58	75	80	79	74	59	76	81	80	75	60	77	82	81	76
61	78	83	82	77	62	80	85	84	79	63	81	86	85	80
64	82	87	86	81	65	83	88	87	82	66	86	90	89	84
67	88	91	90	86	68	91	93	92	89	69	93	95	94	92
70	95	97	96	94	71	100	99	98	4	72	102	101	99	100
73	104	103	101	102	74	106	105	103	104	75	108	107	105	106
76	99	109	3	98	77	101	110	109	99	78	103	111	110	101
79	105	112	111	103	80	107	113	112	105	81	109	114	8	3
82	110	115	114	109	83	111	116	115	110	84	112	117	116	111
85	113	118	117	112	86	114	119	11	8	87	115	120	119	114
88	116	121	120	115	89	117	122	121	116	90	118	123	122	117
91	119	124	18	11	92	120	125	124	119	93	121	126	125	120
94	122	127	126	121	95	123	128	127	122	96	124	129	23	18
97	125	130	129	124	98	126	131	130	125	99	127	132	131	126
100	128	133	132	127	101	129	134	28	23	102	130	135	134	129
103	131	136	135	130	104	132	137	136	131	105	133	138	137	132
106	134	139	33	28	107	135	140	139	134	108	136	141	140	135
109	137	142	141	136	110	138	143	142	137	111	139	144	38	33
112	140	145	144	139	113	141	146	145	140	114	142	147	146	141
115	143	148	147	142	116	144	149	43	38	117	145	150	149	144
118	146	151	150	145	119	147	152	151	146	120	148	153	152	147
121	149	154	48	43	122	150	155	154	149	123	151	156	155	150
124	152	157	156	151	125	153	158	157	152	126	154	159	53	48
127	155	160	159	154	128	156	161	160	155	129	157	162	161	156
130	158	163	162	157	131	159	164	58	53	132	160	165	164	159
133	161	166	165	160	134	162	167	166	161	135	163	168	167	162
136	164	169	63	58	137	165	170	169	164	138	166	171	170	165
139	167	172	171	166	140	168	173	172	167	141	169	174	68	63
142	170	175	174	169	143	171	176	175	170	144	172	177	176	171
145	173	178	177	172	146	174	179	73	68	147	175	180	179	174
148	176	181	180	175	149	177	182	181	176	150	178	183	182	177
151	179	184	78	73	152	180	185	184	179	153	181	186	185	180
154	182	187	186	181	155	183	188	187	182	156	184	189	83	78
157	185	190	189	184	158	186	191	190	185	159	187	192	191	186
160	188	193	192	187	161	189	194	88	83	162	190	195	194	189
163	191	196	195	190	164	192	197	196	191	165	193	198	197	192
166	194	199	91	88	167	195	200	199	194	168	196	201	200	195

169	197	202	201	196	170	198	203	202	197	171	199	204	93	91
172	200	205	204	199	173	201	206	205	200	174	202	207	206	201
175	203	208	207	202	176	204	209	95	93	177	205	210	209	204
178	206	211	210	205	179	207	212	211	206	180	208	213	212	207
181	209	215	214	95	182	210	216	215	209	183	211	217	216	210
184	212	218	217	211	185	213	219	218	212	186	215	220	97	214
187	216	221	220	215	188	217	222	221	216	189	218	223	222	217
190	219	224	223	218										

NONDIMENSIONAL HYDRODYNAMIC COEFFICIENTS

NO.	LAMDA/L	W*SQRT(L/g)	PERIODS	A11	A22	A33	A44	A55	A66
1	.500	3.545	6.302	.016	.146	1.129	.000	.048	.017
NO.	LAMDA/L	W*SQRT(L/g)	PERIODS	B11	B22	B33	B44	B55	B66
1	.500	3.545	6.302	.119	2.228	.583	.000	.036	.150

NONDIMENSIONAL WAVE EXCITING FORCES

NO.	LAMDA/L	W*SQRT(L/g)	PERIODS	F1	F2	F3	F4	F5	F6
1	.500	3.545	6.302	.052	.009	.041	.000	.034	.006

NONDIMENSIONAL TRANSFER FUNCTION: MOTION AMPLITUDE (Y/A) AND PHASE ANGLE (EP)

NO.	LAMDA/L	W*SQRT(L/g)	PERIODS	Y1/A	Y2/A	Y3/A	Y4/KA	Y5/KA	Y6/KA
1	.500	3.545	6.302	.038	.006	.012	.004	.032	.003
NO.	LAMDA/L	W*SQRT(L/g)	PERIODS	EP1	EP2	EP3	EP4	EP5	EP6
1	.500	3.545	6.302	-39.87	116.33	-104.96	-125.19	-73.13	-73.13

NONDIMENSIONAL SEA LOADS:

NO.	LAMDA/L	W*SQRT(L/g)	PERIODS	shfv-3	bemv-5	shfh-2	bemh-6	bemt-4
1	.500	3.545	6.302	.023	.006	.011	.001	.001

Appendix VI The s60c08.chk File

centroidal coordinates and aeras:

1	57.369	.402	-7.086	2.8356
2	54.104	.431	-7.086	2.6023
3	54.104	1.293	-7.086	2.6022
4	51.050	.677	-7.086	4.1426
5	51.051	2.027	-7.086	4.1309
6	46.249	.537	-7.086	6.5348
7	46.249	1.612	-7.086	6.5348
8	46.249	2.687	-7.086	6.5348
9	46.244	3.761	-7.086	6.5115
10	40.166	.757	-7.086	9.3354
11	40.166	2.271	-7.086	9.3354
12	40.166	3.785	-7.086	9.3354
13	40.168	5.297	-7.086	9.3121
14	34.053	.892	-7.086	11.0508
15	34.053	2.675	-7.086	11.0508
16	34.053	4.459	-7.086	11.0508
17	34.051	6.241	-7.086	11.0275
18	27.895	.936	-7.086	11.6109
19	27.895	2.809	-7.086	11.6109
20	27.895	4.682	-7.086	11.6109
21	27.895	6.555	-7.086	11.6109
22	21.700	.941	-7.086	11.6693
23	21.700	2.823	-7.086	11.6693
24	21.700	4.705	-7.086	11.6693
25	21.700	6.588	-7.086	11.6693
26	15.500	.941	-7.086	11.6693
27	15.500	2.823	-7.086	11.6693
28	15.500	4.705	-7.086	11.6693
29	15.500	6.588	-7.086	11.6693
30	9.300	.941	-7.086	11.6693
31	9.300	2.823	-7.086	11.6693
32	9.300	4.705	-7.086	11.6693
33	9.300	6.588	-7.086	11.6693
34	3.100	.941	-7.086	11.6693
35	3.100	2.823	-7.086	11.6693
36	3.100	4.705	-7.086	11.6693
37	3.100	6.588	-7.086	11.6693
38	-3.100	.941	-7.086	11.6693
39	-3.100	2.823	-7.086	11.6693
40	-3.100	4.705	-7.086	11.6693
41	-3.100	6.588	-7.086	11.6693
42	-9.298	.939	-7.086	11.6460
43	-9.298	2.818	-7.086	11.6460
44	-9.298	4.696	-7.086	11.6460

45	-9.298	6.574	-7.086	11.6460
46	-15.480	.920	-7.086	11.4009
47	-15.480	2.759	-7.086	11.4009
48	-15.480	4.598	-7.086	11.4009
49	-15.480	6.437	-7.086	11.4009
50	-21.643	.855	-7.086	10.5957
51	-21.643	2.566	-7.086	10.5957
52	-21.643	4.277	-7.086	10.5957
53	-21.643	5.987	-7.086	10.5957
54	-27.785	.730	-7.086	9.0087
55	-27.785	2.189	-7.086	9.0087
56	-27.785	3.648	-7.086	9.0087
57	-27.785	5.107	-7.086	9.0087
58	-33.924	.557	-7.086	6.8382
59	-33.924	1.670	-7.086	6.8382
60	-33.924	2.784	-7.086	6.8382
61	-33.924	3.898	-7.086	6.8382
62	-40.059	.378	-7.086	4.5977
63	-40.059	1.133	-7.086	4.5977
64	-40.059	1.888	-7.086	4.5977
65	-40.059	2.643	-7.086	4.5977
66	-46.140	.439	-7.086	5.2278
67	-46.140	1.316	-7.086	5.2278
68	-51.033	.456	-7.086	2.7773
69	-54.073	.268	-7.086	1.5987
70	-57.129	.113	-7.086	.6767
71	59.815	.485	-6.775	1.8309
72	60.075	.854	-5.909	3.8905
73	60.170	1.088	-4.418	5.9607
74	60.266	1.167	-2.648	6.3534
75	60.387	1.227	-.874	6.8386
76	57.249	1.473	-6.803	4.3673
77	57.309	2.528	-5.918	5.1278
78	57.336	3.120	-4.421	6.5290
79	57.346	3.352	-2.655	6.6099
80	57.351	3.499	-.886	6.6504
81	54.211	2.550	-6.813	5.6093
82	54.243	3.949	-5.931	5.3747
83	54.240	4.758	-4.423	6.2330
84	54.245	5.135	-2.654	6.1460
85	54.249	5.331	-.885	6.1736
86	51.146	3.608	-6.819	6.0700
87	51.149	5.113	-5.934	5.3810
88	51.148	5.993	-4.428	6.1318
89	51.149	6.449	-2.656	5.9018
90	51.149	6.683	-.885	5.8770
91	46.587	5.054	-6.827	11.2874
92	46.557	6.446	-5.946	10.1073
93	46.515	7.236	-4.433	11.7820
94	46.504	7.646	-2.658	11.3374
95	46.502	7.865	-.886	11.2410
96	40.427	6.684	-6.831	9.1967
97	40.360	7.759	-5.946	8.9685

98	40.318	8.287	-4.434	11.2797
99	40.305	8.527	-2.659	11.0741
100	40.302	8.655	-.886	11.0208
101	34.146	7.684	-6.824	7.7053
102	34.131	8.473	-5.941	8.1627
103	34.103	8.733	-4.429	11.0210
104	34.101	8.808	-2.657	10.9929
105	34.100	8.845	-.886	10.9848
106	27.899	8.022	-6.820	7.3620
107	27.903	8.696	-5.935	7.8856
108	27.900	8.844	-4.429	10.9836
109	27.900	8.854	-2.657	10.9832
110	27.900	8.857	-.886	10.9829
111	21.700	8.060	-6.820	7.3675
112	21.700	8.724	-5.934	7.8625
113	21.700	8.857	-4.429	10.9829
114	21.700	8.857	-2.657	10.9829
115	21.700	8.857	-.886	10.9829
116	15.500	8.060	-6.820	7.3675
117	15.500	8.724	-5.934	7.8625
118	15.500	8.857	-4.429	10.9829
119	15.500	8.857	-2.657	10.9828
120	15.500	8.857	-.886	10.9829
121	9.300	8.060	-6.820	7.3675
122	9.300	8.724	-5.934	7.8625
123	9.300	8.857	-4.429	10.9829
124	9.300	8.857	-2.657	10.9829
125	9.300	8.857	-.886	10.9829
126	3.100	8.060	-6.820	7.3675
127	3.100	8.724	-5.934	7.8625
128	3.100	8.857	-4.429	10.9829
129	3.100	8.857	-2.657	10.9829
130	3.100	8.857	-.886	10.9829
131	-3.100	8.060	-6.820	7.3675
132	-3.100	8.724	-5.934	7.8625
133	-3.100	8.857	-4.429	10.9829
134	-3.100	8.857	-2.657	10.9828
135	-3.100	8.857	-.886	10.9829
136	-9.302	8.046	-6.820	7.3796
137	-9.302	8.716	-5.934	7.8801
138	-9.300	8.857	-4.429	10.9829
139	-9.300	8.857	-2.657	10.9829
140	-9.300	8.857	-.886	10.9829
141	-15.540	7.912	-6.817	7.6886
142	-15.516	8.646	-5.931	8.0256
143	-15.500	8.845	-4.429	10.9840
144	-15.500	8.857	-2.657	10.9828
145	-15.500	8.857	-.886	10.9829
146	-21.753	7.452	-6.815	8.4232
147	-21.740	8.348	-5.926	8.5134
148	-21.706	8.714	-4.427	11.0667
149	-21.700	8.831	-2.657	10.9889
150	-21.700	8.857	-.886	10.9829

151	-27.967	6.512	-6.814	9.4858
152	-27.959	7.646	-5.923	9.4708
153	-27.920	8.303	-4.423	11.4287
154	-27.905	8.628	-2.656	11.0723
155	-27.901	8.757	-.885	11.0056
156	-34.149	5.211	-6.816	10.6211
157	-34.107	6.553	-5.933	10.1711
158	-34.129	7.434	-4.420	12.1828
159	-34.119	8.040	-2.652	11.4600
160	-34.107	8.398	-.884	11.1556
161	-40.247	3.789	-6.825	10.5857
162	-40.289	5.105	-5.936	10.1981
163	-40.308	6.093	-4.426	12.8362
164	-40.331	6.947	-2.648	12.3121
165	-40.328	7.620	-.878	11.7239
166	-46.390	2.392	-6.829	9.0617
167	-46.449	3.499	-5.945	9.5873
168	-46.481	4.365	-4.434	12.8063
169	-46.522	5.311	-2.651	13.2950
170	-46.562	6.341	-.868	13.1732
171	-51.095	1.432	-6.830	3.6438
172	-51.136	2.249	-5.940	4.3809
173	-51.145	2.884	-4.431	6.1849
174	-51.148	3.791	-2.658	6.8698
175	-51.169	5.097	-.875	7.4861
176	-54.176	.904	-6.833	2.8327
177	-54.243	1.443	-5.937	4.1356
178	-54.248	1.852	-4.430	5.9759
179	-54.242	2.574	-2.662	6.7191
180	-54.273	3.973	-.873	8.3939
181	-57.266	.430	-6.834	2.0674
182	-57.349	.656	-5.935	4.0032
183	-57.353	.827	-4.427	5.8259
184	-57.346	1.231	-2.659	6.3905
185	-57.369	2.609	-.875	9.4357
186	-59.263	.096	-6.819	.4008
187	-59.264	.131	-5.932	.9535
188	-59.263	.150	-4.427	1.3879
189	-59.332	.252	-2.603	1.7316
190	-60.687	1.474	-.681	10.3289

normals in six modes: numerical solutions

i=	1	.0000	.0000	-1.0000	-.4016	54.2691	.0000
i=	2	.0000	.0000	-1.0000	-.4309	51.0040	.0000
i=	3	.0000	.0000	-1.0000	-1.2927	51.0040	.0000
i=	4	.0000	.0000	-1.0000	-.6766	47.9496	.0000
i=	5	.0000	.0000	-1.0000	-2.0274	47.9508	.0000
i=	6	.0000	.0000	-1.0000	-.5374	43.1490	.0000
i=	7	.0000	.0000	-1.0000	-1.6121	43.1490	.0000
i=	8	.0000	.0000	-1.0000	-2.6868	43.1491	.0000
i=	9	.0000	.0000	-1.0000	-3.7611	43.1444	.0000

i= 10	.0000	.0000	-1.0000	-.7571	37.0657	.0000
i= 11	.0000	.0000	-1.0000	-2.2713	37.0657	.0000
i= 12	.0000	.0000	-1.0000	-3.7855	37.0657	.0000
i= 13	.0000	.0000	-1.0000	-5.2972	37.0679	.0000
i= 14	.0000	.0000	-1.0000	-.8918	30.9531	.0000
i= 15	.0000	.0000	-1.0000	-2.6754	30.9531	.0000
i= 16	.0000	.0000	-1.0000	-4.4590	30.9531	.0000
i= 17	.0000	.0000	-1.0000	-6.2410	30.9508	.0000
i= 18	.0000	.0000	-1.0000	-.9364	24.7948	.0000
i= 19	.0000	.0000	-1.0000	-2.8091	24.7948	.0000
i= 20	.0000	.0000	-1.0000	-4.6819	24.7948	.0000
i= 21	.0000	.0000	-1.0000	-6.5546	24.7948	.0000
i= 22	.0000	.0000	-1.0000	-.9411	18.6000	.0000
i= 23	.0000	.0000	-1.0000	-2.8232	18.6000	.0000
i= 24	.0000	.0000	-1.0000	-4.7054	18.6000	.0000
i= 25	.0000	.0000	-1.0000	-6.5875	18.6000	.0000
i= 26	.0000	.0000	-1.0000	-.9411	12.4000	.0000
i= 27	.0000	.0000	-1.0000	-2.8232	12.4000	.0000
i= 28	.0000	.0000	-1.0000	-4.7054	12.4000	.0000
i= 29	.0000	.0000	-1.0000	-6.5875	12.4000	.0000
i= 30	.0000	.0000	-1.0000	-.9411	6.2000	.0000
i= 31	.0000	.0000	-1.0000	-2.8232	6.2000	.0000
i= 32	.0000	.0000	-1.0000	-4.7054	6.2000	.0000
i= 33	.0000	.0000	-1.0000	-6.5875	6.2000	.0000
i= 34	.0000	.0000	-1.0000	-.9411	.0000	.0000
i= 35	.0000	.0000	-1.0000	-2.8232	.0000	.0000
i= 36	.0000	.0000	-1.0000	-4.7054	.0000	.0000
i= 37	.0000	.0000	-1.0000	-6.5875	.0000	.0000
i= 38	.0000	.0000	-1.0000	-.9411	-6.2000	.0000
i= 39	.0000	.0000	-1.0000	-2.8232	-6.2000	.0000
i= 40	.0000	.0000	-1.0000	-4.7054	-6.2000	.0000
i= 41	.0000	.0000	-1.0000	-6.5875	-6.2000	.0000
i= 42	.0000	.0000	-1.0000	-.9392	-12.3979	.0000
i= 43	.0000	.0000	-1.0000	-2.8176	-12.3979	.0000
i= 44	.0000	.0000	-1.0000	-4.6960	-12.3979	.0000
i= 45	.0000	.0000	-1.0000	-6.5743	-12.3979	.0000
i= 46	.0000	.0000	-1.0000	-.9195	-18.5799	.0000
i= 47	.0000	.0000	-1.0000	-2.7586	-18.5799	.0000
i= 48	.0000	.0000	-1.0000	-4.5977	-18.5799	.0000
i= 49	.0000	.0000	-1.0000	-6.4368	-18.5799	.0000
i= 50	.0000	.0000	-1.0000	-.8554	-24.7431	.0000
i= 51	.0000	.0000	-1.0000	-2.5661	-24.7431	.0000
i= 52	.0000	.0000	-1.0000	-4.2768	-24.7431	.0000
i= 53	.0000	.0000	-1.0000	-5.9875	-24.7431	.0000
i= 54	.0000	.0000	-1.0000	-.7295	-30.8849	.0000
i= 55	.0000	.0000	-1.0000	-2.1885	-30.8849	.0000
i= 56	.0000	.0000	-1.0000	-3.6476	-30.8849	.0000
i= 57	.0000	.0000	-1.0000	-5.1066	-30.8849	.0000
i= 58	.0000	.0000	-1.0000	-.5568	-37.0237	.0000
i= 59	.0000	.0000	-1.0000	-1.6705	-37.0237	.0000
i= 60	.0000	.0000	-1.0000	-2.7841	-37.0237	.0000
i= 61	.0000	.0000	-1.0000	-3.8977	-37.0237	.0000
i= 62	.0000	.0000	-1.0000	-.3775	-43.1587	.0000

i= 63	.0000	.0000	-1.0000	-1.1326	-43.1587	.0000
i= 64	.0000	.0000	-1.0000	-1.8876	-43.1587	.0000
i= 65	.0000	.0000	-1.0000	-2.6426	-43.1587	.0000
i= 66	.0000	.0000	-1.0000	-.4386	-49.2402	.0000
i= 67	.0000	.0000	-1.0000	-1.3159	-49.2402	.0000
i= 68	.0000	.0000	-1.0000	-.4556	-54.1328	.0000
i= 69	.0000	.0000	-1.0000	-.2680	-57.1727	.0000
i= 70	.0000	.0000	-1.0000	-.1131	-60.2293	.0000
i= 71	.2577	.5683	-.7207	2.8361	39.4276	32.1070
i= 72	.5535	.7735	-.2423	3.4586	11.1838	43.5996
i= 73	.6488	.7577	-.0661	2.3892	1.6644	42.5350
i= 74	.6482	.7588	-.0575	1.0547	2.3292	42.6209
i= 75	.6344	.7683	-.0845	-.3311	5.0274	43.2342
i= 76	.1337	.3772	-.9128	.7800	48.6735	20.2293
i= 77	.3825	.7496	-.5317	2.2153	27.0048	39.6707
i= 78	.5143	.8411	-.1556	2.2487	6.7675	44.0128
i= 79	.5531	.8308	-.0582	1.0386	2.3335	43.2132
i= 80	.5591	.8257	-.0743	-.4944	4.1904	42.8397
i= 81	.1031	.2937	-.9500	-.7652	47.9751	14.7481
i= 82	.2909	.7152	-.6353	.8966	31.1077	35.4290
i= 83	.3902	.8810	-.2643	1.6083	12.2475	43.1991
i= 84	.4340	.8935	-.1117	.7526	5.0680	43.4689
i= 85	.4498	.8895	-.0801	-.6800	4.2229	43.0993
i= 86	.0918	.2714	-.9581	-1.9237	45.5129	12.7086
i= 87	.2462	.7144	-.6550	.0539	30.3002	33.0656
i= 88	.3134	.8956	-.3157	1.0255	14.1472	41.1521
i= 89	.3336	.9305	-.1512	.4081	6.7691	42.5562
i= 90	.3431	.9344	-.0958	-.9063	4.6996	42.6037
i= 91	.0892	.2919	-.9519	-3.1600	40.8916	12.2430
i= 92	.1961	.7606	-.6154	-.3339	25.8048	31.7907
i= 93	.2077	.9322	-.2936	.9169	12.0703	38.9672
i= 94	.1986	.9687	-.1477	.3121	6.1165	40.5280
i= 95	.1912	.9770	-.0928	-1.0071	4.0827	40.9015
i= 96	.0788	.3583	-.9291	-4.1822	34.2334	12.8463
i= 97	.1389	.8572	-.4857	.3254	17.4350	30.8621
i= 98	.1092	.9737	-.1826	1.6648	6.4383	35.3335
i= 99	.0765	.9918	-.0942	.6728	3.3914	36.2458
i=100	.0577	.9966	-.0523	-.7356	1.9627	36.5749
i=101	.0410	.4276	-.9028	-4.5195	27.7964	12.9608
i=102	.0627	.9418	-.3182	1.7969	9.5754	28.6955
i=103	.0342	.9965	-.0598	2.7261	1.7424	30.5976
i=104	.0150	.9991	-.0325	1.2000	.9843	30.8406
i=105	.0050	.9998	-.0125	-.3947	.3889	30.9505
i=106	.0055	.4475	-.8942	-4.6448	22.1454	11.0547
i=107	.0096	.9749	-.2219	2.7157	5.4583	24.0982
i=108	.0050	.9999	-.0075	3.1920	.1697	24.7541
i=109	.0014	1.0000	-.0050	1.4428	.1219	24.7867
i=110	.0000	1.0000	.0000	-.2843	.0000	24.8000
i=111	.0000	.4472	-.8944	-4.6823	16.6363	8.3182
i=112	.0000	.9778	-.2095	2.8305	3.8972	18.1871
i=113	.0000	1.0000	.0000	3.2586	.0000	18.6000
i=114	.0000	1.0000	.0000	1.4871	.0000	18.6000
i=115	.0000	1.0000	.0000	-.2843	.0000	18.6000

i=116	.0000	.4472	-.8944	-4.6823	11.0909	5.5454
i=117	.0000	.9778	-.2095	2.8305	2.5982	12.1248
i=118	.0000	1.0000	.0000	3.2586	.0000	12.4000
i=119	.0000	1.0000	.0000	1.4871	.0000	12.4000
i=120	.0000	1.0000	.0000	-.2843	.0000	12.4000
i=121	.0000	.4472	-.8944	-4.6823	5.5455	2.7727
i=122	.0000	.9778	-.2095	2.8305	1.2991	6.0624
i=123	.0000	1.0000	.0000	3.2586	.0000	6.2000
i=124	.0000	1.0000	.0000	1.4871	.0000	6.2000
i=125	.0000	1.0000	.0000	-.2843	.0000	6.2000
i=126	.0000	.4472	-.8944	-4.6823	.0000	.0000
i=127	.0000	.9778	-.2095	2.8305	.0000	.0000
i=128	.0000	1.0000	.0000	3.2586	.0000	.0000
i=129	.0000	1.0000	.0000	1.4871	.0000	.0000
i=130	.0000	1.0000	.0000	-.2843	.0000	.0000
i=131	.0000	.4472	-.8944	-4.6823	-5.5454	-2.7727
i=132	.0000	.9778	-.2095	2.8305	-1.2991	-6.0624
i=133	.0000	1.0000	.0000	3.2586	.0000	-6.2000
i=134	.0000	1.0000	.0000	1.4871	.0000	-6.2000
i=135	.0000	1.0000	.0000	-.2843	.0000	-6.2000
i=136	-.0020	.4465	-.8948	-4.6769	-11.0855	-5.5209
i=137	-.0020	.9756	-.2192	2.7372	-2.7089	-12.0823
i=138	.0000	1.0000	.0000	3.2586	.0000	-12.4000
i=139	.0000	1.0000	.0000	1.4871	.0000	-12.4000
i=140	.0000	1.0000	.0000	-.2843	.0000	-12.4000
i=141	-.0161	.4285	-.9032	-4.7265	-16.7440	-7.8603
i=142	-.0167	.9579	-.2812	2.1296	-5.1552	-17.6888
i=143	-.0029	.9999	-.0100	3.1697	-.1767	-18.5728
i=144	.0000	1.0000	.0000	1.4871	.0000	-18.6000
i=145	.0000	1.0000	.0000	-.2843	.0000	-18.6000
i=146	-.0427	.3912	-.9190	-4.6408	-22.5995	-9.4031
i=147	-.0683	.9031	-.4143	.8367	-9.9665	-21.8615
i=148	-.0333	.9924	-.0918	2.4322	-2.1687	-24.3278
i=149	-.0064	.9995	-.0225	1.2876	-.5481	-24.7302
i=150	.0000	1.0000	.0000	-.2843	.0000	-24.8000
i=151	-.0666	.3473	-.9350	-4.1284	-28.6714	-10.3572
i=152	-.1207	.8118	-.5641	-.4553	-16.9468	-24.2889
i=153	-.0934	.9610	-.2451	1.0914	-7.2977	-29.0343
i=154	-.0553	.9919	-.0992	.6179	-2.9933	-30.2774
i=155	-.0285	.9979	-.0399	-.6336	-1.2456	-30.6876
i=156	-.0710	.3102	-.9478	-3.1876	-34.9060	-11.1856
i=157	-.1600	.7559	-.6348	-.5595	-22.8570	-27.0755
i=158	-.1648	.9015	-.3922	.0149	-14.0636	-32.3365
i=159	-.1246	.9584	-.2396	-.5063	-8.7328	-34.6677
i=160	-.0837	.9845	-.1403	-1.4601	-5.2439	-35.9285
i=161	-.0742	.3113	-.9472	-1.8293	-40.6395	-13.2106
i=162	-.1947	.7539	-.6274	.3905	-26.2927	-31.7161
i=163	-.2194	.8556	-.4684	-.0681	-19.6200	-35.8038
i=164	-.1975	.8920	-.3970	-1.4390	-16.9484	-37.3702
i=165	-.1506	.9368	-.2974	-2.5400	-12.9607	-39.5354
i=166	-.0788	.3636	-.9271	-.1596	-45.4347	-17.8063
i=167	-.2152	.8019	-.5506	1.9023	-26.2518	-38.9796
i=168	-.2659	.8576	-.4374	.8900	-20.8180	-41.3605

i=169	-.2561	.8261	-.4998	-1.4311-24.4210-39.6320
i=170	-.2049	.8337	-.4961	-3.3976-24.6977-40.1057
i=171	-.0804	.4521	-.8860	1.2900-47.5633-24.3871
i=172	-.2301	.8774	-.4122	3.2582-21.2575-47.0717
i=173	-.2968	.8879	-.3463	1.8972-17.8156-47.3072
i=174	-.3015	.7994	-.5196	-.7799-27.7376-42.2206
i=175	-.2410	.7336	-.6309	-3.4321-34.3068-38.5803
i=176	-.0977	.5816	-.7989	2.5714-45.2078-33.2226
i=177	-.2385	.9295	-.2679	4.0443-14.2248-52.9551
i=178	-.3072	.9189	-.2343	2.5616-12.4369-52.1302
i=179	-.3433	.8173	-.4577	.0413-25.7323-45.9815
i=180	-.2579	.6542	-.7066	-3.0016-40.6135-36.5093
i=181	-.1182	.7968	-.5164	4.2915-30.5047-48.0513
i=182	-.2395	.9602	-.1198	4.4966 -6.0998-57.8878
i=183	-.3084	.9426	-.0919	2.9937 -4.5516-56.7280
i=184	-.3965	.8593	-.2857	.9282-16.6802-51.4541
i=185	-.2843	.5820	-.7595	-2.1531-46.0093-34.4501
i=186	-.2030	.9613	-.0999	5.4210 -5.0828-59.9276
i=187	-.3295	.9429	-.0228	4.4866 .1454-58.7572
i=188	-.3787	.9253	-.0069	3.0125 .8005-57.6499
i=189	-.4802	.8649	-.1105	1.2119 -6.2111-53.8790
i=190	-.2005	.5279	-.8224	-1.4707-52.5551-33.3768

potential functions and its derivatives:

i= 1	-1.953	-.121	-.064	.000
i= 2	-1.675	-.091	-.024	.000
i= 3	-1.719	-.103	-.087	.000
i= 4	-1.464	-.074	-.020	.000
i= 5	-1.521	-.087	-.074	.000
i= 6	-1.165	-.069	-.007	.000
i= 7	-1.179	-.071	-.021	.000
i= 8	-1.210	-.077	-.041	.000
i= 9	-1.270	-.090	-.081	.000
i= 10	-.859	-.051	-.004	.000
i= 11	-.870	-.053	-.012	.000
i= 12	-.895	-.057	-.024	.000
i= 13	-.947	-.068	-.055	.000
i= 14	-.620	-.037	-.002	.000
i= 15	-.625	-.038	-.005	.000
i= 16	-.637	-.041	-.010	.000
i= 17	-.662	-.047	-.024	.000
i= 18	-.437	-.027	.000	.000
i= 19	-.438	-.028	-.001	.000
i= 20	-.441	-.029	-.002	.000
i= 21	-.446	-.030	-.004	.000
i= 22	-.297	-.020	.000	.000
i= 23	-.297	-.021	.000	.000
i= 24	-.296	-.021	.000	.000
i= 25	-.296	-.021	.000	.000
i= 26	-.185	-.017	.000	.000
i= 27	-.185	-.017	.000	.000

i= 28	-.184	-.017	.000	.000
i= 29	-.184	-.017	.000	.000
i= 30	-.089	-.015	.000	.000
i= 31	-.089	-.015	.000	.000
i= 32	-.089	-.015	.000	.000
i= 33	-.088	-.015	.000	.000
i= 34	.001	-.015	.000	.000
i= 35	.001	-.015	.000	.000
i= 36	.001	-.015	.000	.000
i= 37	.001	-.014	.000	.000
i= 38	.093	-.016	.000	.000
i= 39	.093	-.016	.000	.000
i= 40	.092	-.016	.000	.000
i= 41	.092	-.016	.000	.000
i= 42	.195	-.018	.000	.000
i= 43	.195	-.018	.000	.000
i= 44	.196	-.019	.000	.000
i= 45	.196	-.019	.001	.000
i= 46	.318	-.023	.000	.000
i= 47	.319	-.023	.001	.000
i= 48	.323	-.024	.003	.000
i= 49	.330	-.026	.007	.000
i= 50	.470	-.030	.001	.000
i= 51	.475	-.031	.005	.000
i= 52	.486	-.033	.009	.000
i= 53	.509	-.037	.023	.000
i= 54	.658	-.037	.003	.000
i= 55	.666	-.038	.010	.000
i= 56	.686	-.042	.020	.000
i= 57	.728	-.049	.046	.000
i= 58	.879	-.044	.005	.000
i= 59	.890	-.045	.016	.000
i= 60	.915	-.049	.032	.000
i= 61	.963	-.057	.065	.000
i= 62	1.127	-.049	.007	.000
i= 63	1.138	-.051	.023	.000
i= 64	1.161	-.054	.044	.000
i= 65	1.206	-.062	.083	.000
i= 66	1.382	-.052	.020	.000
i= 67	1.419	-.058	.075	.000
i= 68	1.566	-.037	.049	.000
i= 69	1.635	-.026	.056	.000
i= 70	1.652	.013	.075	.000
i= 71	-2.424	-.097	-.151	-.511
i= 72	-2.996	.226	.402	-.485
i= 73	-3.512	.404	.485	-.289
i= 74	-3.814	.436	.469	-.159
i= 75	-3.910	.434	.459	-.074
i= 76	-2.173	-.143	-.183	-.243
i= 77	-2.740	-.006	.150	-.512
i= 78	-3.325	.172	.445	-.331
i= 79	-3.693	.232	.500	-.165
i= 80	-3.835	.246	.503	-.078

i= 81	-1.952	-.126	-.144	-.167
i= 82	-2.441	-.062	.065	-.413
i= 83	-2.920	.029	.336	-.312
i= 84	-3.239	.068	.432	-.166
i= 85	-3.372	.083	.457	-.070
i= 86	-1.756	-.108	-.120	-.140
i= 87	-2.167	-.067	.060	-.336
i= 88	-2.522	-.025	.269	-.254
i= 89	-2.742	-.022	.344	-.137
i= 90	-2.832	-.023	.370	-.056
i= 91	-1.478	-.097	-.092	-.131
i= 92	-1.763	-.061	.072	-.250
i= 93	-1.959	-.053	.186	-.155
i= 94	-2.061	-.066	.207	-.073
i= 95	-2.094	-.074	.207	-.029
i= 96	-1.104	-.074	-.055	-.112
i= 97	-1.251	-.055	.089	-.145
i= 98	-1.307	-.067	.110	-.051
i= 99	-1.306	-.081	.083	-.009
i=100	-1.291	-.087	.063	-.001
i=101	-.733	-.050	-.021	-.057
i=102	-.789	-.048	.053	-.050
i=103	-.793	-.055	.036	-.005
i=104	-.779	-.059	.016	.005
i=105	-.766	-.059	.005	.003
i=106	-.458	-.032	-.006	-.010
i=107	-.473	-.033	.008	-.011
i=108	-.480	-.035	.005	-.003
i=109	-.481	-.035	.001	.000
i=110	-.480	-.035	.000	.000
i=111	-.297	-.021	-.001	-.001
i=112	-.300	-.022	-.001	-.003
i=113	-.304	-.022	.000	-.002
i=114	-.307	-.023	.000	-.001
i=115	-.308	-.023	.000	.000
i=116	-.184	-.017	.000	.000
i=117	-.184	-.017	.000	-.001
i=118	-.186	-.017	.000	-.001
i=119	-.187	-.017	.000	-.001
i=120	-.188	-.017	.000	.000
i=121	-.088	-.015	.000	.000
i=122	-.088	-.015	.000	.000
i=123	-.089	-.015	.000	.000
i=124	-.089	-.015	.000	.000
i=125	-.089	-.015	.000	.000
i=126	.001	-.014	.000	.000
i=127	.001	-.014	.000	.000
i=128	.001	-.015	.000	.000
i=129	.001	-.015	.000	.000
i=130	.001	-.015	.000	.000
i=131	.092	-.016	.000	.000
i=132	.093	-.016	.000	.001
i=133	.093	-.016	.000	.001

i=134	.094	-.016	.000	.000
i=135	.094	-.016	.000	.000
i=136	.199	-.019	.000	.003
i=137	.201	-.020	-.002	.002
i=138	.201	-.020	.000	.001
i=139	.202	-.020	.000	.000
i=140	.203	-.020	.000	.000
i=141	.352	-.028	.001	.019
i=142	.359	-.028	-.016	.005
i=143	.351	-.029	-.003	-.002
i=144	.347	-.029	.000	-.001
i=145	.346	-.028	.000	.000
i=146	.577	-.040	.016	.055
i=147	.625	-.035	-.061	.037
i=148	.607	-.042	-.036	-.010
i=149	.573	-.044	-.007	-.011
i=150	.557	-.043	.000	-.004
i=151	.851	-.052	.041	.090
i=152	.967	-.036	-.084	.101
i=153	.985	-.045	-.097	.017
i=154	.946	-.054	-.060	-.014
i=155	.908	-.057	-.031	-.008
i=156	1.118	-.061	.071	.103
i=157	1.323	-.037	-.072	.176
i=158	1.427	-.029	-.153	.081
i=159	1.405	-.044	-.134	.006
i=160	1.347	-.055	-.090	-.005
i=161	1.371	-.067	.097	.116
i=162	1.663	-.031	-.068	.238
i=163	1.846	-.010	-.175	.154
i=164	1.871	-.013	-.198	.060
i=165	1.792	-.030	-.161	.015
i=166	1.596	-.064	.118	.137
i=167	1.938	-.021	-.071	.295
i=168	2.204	.013	-.197	.214
i=169	2.276	.023	-.230	.120
i=170	2.167	.009	-.211	.055
i=171	1.722	-.047	.134	.163
i=172	2.089	.000	-.106	.332
i=173	2.410	.036	-.230	.236
i=174	2.518	.050	-.253	.162
i=175	2.375	.041	-.231	.098
i=176	1.774	-.029	.128	.219
i=177	2.134	.029	-.151	.342
i=178	2.481	.065	-.252	.238
i=179	2.641	.088	-.282	.181
i=180	2.478	.077	-.233	.121
i=181	1.765	.026	.053	.305
i=182	2.070	.085	-.190	.306
i=183	2.416	.125	-.265	.217
i=184	2.642	.172	-.325	.172
i=185	2.482	.156	-.220	.147
i=186	1.696	.119	-.153	.318

i=187	1.933	.236	-.262	.225
i=188	2.219	.318	-.278	.165
i=189	2.446	.352	-.349	.081
i=190	2.031	.224	-.117	.114

M_j terms: numerical solutions

i= 1	-.0420	-.0670	.2636	-.2267	-15.1794	-3.6173
i= 2	-.0057	-.0019	.0488	.0336	-3.5481	-.0962
i= 3	-.0199	-.0566	.1311	-.0783	-7.6729	-2.8591
i= 4	.0003	-.0007	.0277	.0339	-2.4032	-.0352
i= 5	-.0107	-.0360	.0779	.0192	-4.7585	-1.7029
i= 6	-.0036	-.0004	.0136	.0116	-1.6340	-.0145
i= 7	-.0040	-.0017	.0163	.0372	-1.7511	-.0674
i= 8	-.0041	-.0018	.0223	.0898	-2.0127	-.0679
i= 9	-.0210	-.0521	.0783	.0676	-4.3414	-2.1685
i= 10	-.0005	-.0002	.0058	.0071	-1.2637	-.0063
i= 11	-.0009	-.0007	.0072	.0243	-1.3138	-.0241
i= 12	-.0013	.0001	.0101	.0630	-1.4239	.0069
i= 13	-.0118	-.0342	.0472	.1033	-2.7491	-1.2052
i= 14	-.0001	.0000	.0027	.0037	-1.1203	-.0008
i= 15	-.0004	-.0003	.0033	.0121	-1.1374	-.0070
i= 16	-.0009	.0002	.0043	.0304	-1.1681	.0116
i= 17	-.0045	-.0150	.0207	.0642	-1.6607	-.4372
i= 18	.0000	.0000	.0013	.0015	-1.0587	.0001
i= 19	-.0001	.0000	.0014	.0048	-1.0621	-.0004
i= 20	-.0003	.0000	.0017	.0099	-1.0692	.0011
i= 21	-.0012	-.0020	.0050	.0251	-1.1468	-.0414
i= 22	.0000	.0000	.0006	.0006	-1.0321	.0000
i= 23	.0000	.0000	.0006	.0018	-1.0327	.0000
i= 24	.0000	.0000	.0007	.0031	-1.0340	-.0003
i= 25	-.0001	.0001	.0012	.0084	-1.0423	.0029
i= 26	.0000	.0000	.0003	.0002	-1.0206	.0000
i= 27	.0000	.0000	.0003	.0007	-1.0207	-.0001
i= 28	.0000	.0000	.0003	.0012	-1.0209	-.0003
i= 29	.0000	.0001	.0005	.0032	-1.0226	.0009
i= 30	.0000	.0000	.0001	.0001	-1.0158	.0000
i= 31	.0000	.0000	.0001	.0002	-1.0158	-.0001
i= 32	.0000	.0000	.0001	.0004	-1.0158	-.0002
i= 33	.0001	.0000	.0002	.0011	-1.0160	-.0001
i= 34	.0000	.0000	.0000	.0000	-1.0147	.0000
i= 35	.0000	.0000	.0000	-.0001	-1.0147	-.0001
i= 36	.0000	.0000	.0000	-.0001	-1.0146	-.0001
i= 37	.0000	.0000	-.0001	-.0004	-1.0147	-.0003
i= 38	.0000	.0000	-.0002	-.0002	-1.0170	.0000
i= 39	.0000	.0000	-.0002	-.0005	-1.0170	.0000
i= 40	.0000	.0000	-.0002	-.0009	-1.0171	-.0001
i= 41	.0000	-.0001	-.0003	-.0023	-1.0176	.0004
i= 42	.0000	.0000	-.0005	-.0005	-1.0242	.0000
i= 43	.0000	.0000	-.0005	-.0015	-1.0247	.0000
i= 44	-.0001	.0000	-.0006	-.0031	-1.0255	.0005
i= 45	-.0003	.0006	-.0015	-.0068	-1.0355	-.0053

i= 46	-.0001	.0000	-.0010	-.0013	-1.0416	.0000
i= 47	-.0002	.0001	-.0012	-.0043	-1.0446	-.0006
i= 48	-.0004	-.0002	-.0014	-.0103	-1.0490	.0048
i= 49	-.0015	.0054	-.0067	-.0182	-1.1422	-.0905
i= 50	-.0003	.0000	-.0021	-.0031	-1.0807	-.0003
i= 51	-.0005	.0002	-.0026	-.0099	-1.0926	-.0046
i= 52	-.0009	-.0004	-.0034	-.0262	-1.1117	.0131
i= 53	-.0042	.0157	-.0194	-.0465	-1.4930	-.3643
i= 54	-.0006	.0001	-.0043	-.0057	-1.1661	-.0021
i= 55	-.0008	.0006	-.0054	-.0183	-1.1989	-.0159
i= 56	-.0012	-.0002	-.0073	-.0482	-1.2610	.0116
i= 57	-.0083	.0295	-.0382	-.0668	-2.1808	-.8683
i= 58	-.0011	.0002	-.0085	-.0083	-1.3512	-.0085
i= 59	-.0014	.0010	-.0104	-.0274	-1.4216	-.0366
i= 60	-.0016	.0006	-.0143	-.0678	-1.5673	-.0182
i= 61	-.0115	.0409	-.0582	-.0497	-3.1443	-1.4709
i= 62	-.0022	.0006	-.0175	-.0102	-1.7905	-.0257
i= 63	-.0025	.0022	-.0206	-.0335	-1.9253	-.0902
i= 64	-.0027	.0022	-.0275	-.0827	-2.2253	-.0886
i= 65	-.0163	.0629	-.0895	.0526	-4.8265	-2.6708
i= 66	-.0055	.0005	-.0400	-.0341	-2.9870	-.0241
i= 67	-.0153	.0571	-.1036	.1272	-6.0674	-2.7936
i= 68	-.0100	.0555	-.1393	.2165	-8.5212	-3.0012
i= 69	-.0235	.1331	-.2669	.6599	-16.1455	-7.6014
i= 70	-.0377	.5971	-.6461	3.3838	-39.6780	-35.9590
i= 71	-.3664	-.7065	-.6016	-3.8521	35.2491	-40.4757
i= 72	.1573	.3993	-.2623	1.9459	13.7422	21.7961
i= 73	.1756	.2103	-.0561	.8086	2.4032	11.0440
i= 74	.1375	.1476	-.0254	.2821	1.1124	7.5470
i= 75	.1276	.1412	-.0349	-.0668	1.9421	7.2089
i= 76	-.1402	-.2860	-.0523	-1.4291	2.5476	-15.6887
i= 77	-.0454	.0238	-.3152	-.3793	16.5737	.5948
i= 78	.0559	.1667	-.0876	.4777	4.2701	7.9414
i= 79	.0481	.1131	-.0100	.2426	.3365	5.0591
i= 80	.0448	.0977	-.0340	-.1193	1.7558	4.2414
i= 81	-.0663	-.1465	-.0115	-.6702	-.1235	-7.6321
i= 82	-.0401	-.0377	-.2098	-.7539	10.1232	-2.5464
i= 83	.0062	.1049	-.0999	.0523	4.7079	4.3484
i= 84	.0100	.0983	-.0223	.1309	.9520	3.9545
i= 85	.0129	.0907	-.0254	-.1354	1.1973	3.5486
i= 86	-.0414	-.1098	-.0104	-.5049	-.3396	-5.4174
i= 87	-.0212	-.0211	-.1631	-.7340	7.1576	-1.6810
i= 88	.0006	.0806	-.0753	-.0458	3.2133	2.8683
i= 89	-.0103	.0755	-.0213	.0510	.8362	2.6262
i= 90	-.0138	.0765	-.0191	-.1323	.7946	2.6828
i= 91	-.0321	-.0867	-.0358	-.5459	.6834	-3.9190
i= 92	-.0037	.0135	-.1278	-.6132	4.8675	-.2102
i= 93	-.0013	.0548	-.0336	.0253	1.1203	1.3672
i= 94	-.0119	.0362	-.0016	.0817	-.0858	.5876
i= 95	-.0163	.0269	-.0074	-.0566	.2100	.2077
i= 96	-.0203	-.0695	-.0586	-.6937	1.2964	-2.8377
i= 97	.0027	.0563	-.0850	-.3090	2.6198	1.1609
i= 98	-.0069	.0352	.0056	.1907	-.3856	.3151

i= 99	-.0146	.0052	.0138	.1268	-.5939	-.7627
i=100	-.0158	-.0078	.0047	.0405	-.2361	-1.2423
i=101	-.0094	-.0359	-.0408	-.4727	.3679	-1.4891
i=102	-.0019	.0436	-.0278	.0026	.5353	.3786
i=103	-.0065	.0061	.0127	.1339	-.4364	-.8064
i=104	-.0064	-.0064	.0083	.0583	-.2827	-1.2016
i=105	-.0055	-.0109	.0031	.0278	-.1117	-1.3490
i=106	-.0026	-.0106	-.0032	-.0755	-.8285	-.7029
i=107	-.0021	.0049	-.0050	-.0110	-.0950	-.8676
i=108	-.0020	-.0009	.0020	.0182	-.0519	-1.0402
i=109	-.0014	-.0030	.0014	.0081	-.0371	-1.0978
i=110	-.0010	-.0030	.0004	.0043	-.0100	-1.1020
i=111	-.0003	-.0022	.0018	.0032	-.9454	-.4963
i=112	-.0002	-.0016	-.0009	-.0125	-.1960	-1.0264
i=113	-.0002	-.0008	-.0002	-.0024	.0047	-1.0359
i=114	-.0002	-.0009	.0000	-.0001	.0002	-1.0372
i=115	-.0001	-.0008	.0000	.0006	.0000	-1.0366
i=116	.0001	-.0007	.0009	.0030	-.9204	-.4644
i=117	.0001	-.0007	-.0003	-.0045	-.2102	-1.0035
i=118	.0000	-.0003	-.0001	-.0010	.0011	-1.0212
i=119	.0000	-.0003	.0000	.0000	.0000	-1.0214
i=120	.0000	-.0003	.0000	.0002	.0000	-1.0214
i=121	.0001	-.0002	.0003	.0014	-.9101	-.4558
i=122	.0001	-.0003	-.0001	-.0015	-.2126	-.9946
i=123	.0000	-.0001	.0000	-.0004	.0001	-1.0160
i=124	.0000	-.0001	.0000	.0000	.0000	-1.0159
i=125	.0000	-.0001	.0000	.0001	.0000	-1.0159
i=126	.0001	.0001	-.0001	-.0004	-.9076	-.4541
i=127	.0001	.0001	.0000	.0005	-.2128	-.9924
i=128	.0000	.0000	.0000	.0001	-.0001	-1.0148
i=129	.0000	.0000	.0000	.0000	.0000	-1.0147
i=130	.0000	.0000	.0000	.0000	.0000	-1.0147
i=131	.0000	.0005	-.0006	-.0021	-.9120	-.4571
i=132	.0000	.0005	.0001	.0031	-.2118	-.9963
i=133	.0000	.0003	.0001	.0008	.0005	-1.0172
i=134	.0000	.0003	.0000	.0001	.0001	-1.0173
i=135	.0000	.0002	.0000	-.0002	.0000	-1.0173
i=136	-.0006	.0018	.0011	.0172	-.8955	-.4726
i=137	-.0006	-.0010	-.0001	-.0065	-.2216	-.9776
i=138	-.0003	.0014	-.0004	-.0001	-.0045	-1.0342
i=139	-.0002	.0007	.0000	.0008	.0006	-1.0269
i=140	-.0001	.0006	.0000	-.0003	.0000	-1.0267
i=141	-.0024	.0064	.0167	.1590	-.6033	-.5406
i=142	-.0026	-.0146	-.0012	-.0809	-.2997	-.6900
i=143	-.0018	.0047	-.0045	-.0226	-.0889	-1.0994
i=144	-.0011	.0032	-.0006	.0010	-.0087	-1.0777
i=145	-.0007	.0019	.0000	-.0004	-.0004	-1.0577
i=146	-.0071	.0323	.0415	.4553	.1124	-1.1567
i=147	-.0005	-.0531	.0217	-.0789	.1112	.3851
i=148	-.0055	-.0076	-.0193	-.1801	-.5560	-.7979
i=149	-.0043	.0114	-.0080	-.0419	-.2149	-1.2886
i=150	-.0035	.0088	-.0014	-.0116	-.0365	-1.2298
i=151	-.0140	.0564	.0500	.5744	.6415	-2.0242

i=152	.0039	-.0552	.0606	.1669	1.2684	.8334
i=153	-.0043	-.0357	-.0157	-.2388	-.7313	.1286
i=154	-.0084	-.0029	-.0187	-.1464	-.6713	-.8851
i=155	-.0082	.0135	-.0073	-.0583	-.2708	-1.4018
i=156	-.0198	.0717	.0357	.4926	.4293	-2.8938
i=157	.0009	-.0243	.0946	.4170	2.8298	.1008
i=158	.0050	-.0594	.0119	-.1178	.0094	1.2202
i=159	-.0064	-.0286	-.0243	-.2120	-1.1465	.1003
i=160	-.0116	.0084	-.0112	-.0788	-.5682	-1.2602
i=161	-.0266	.0949	.0274	.5122	.3181	-4.3372
i=162	-.0006	-.0173	.1194	.3911	4.4913	-.0382
i=163	.0080	-.0519	.0334	-.0155	.9163	1.2998
i=164	.0041	-.0510	-.0074	-.1021	-.7433	1.2454
i=165	-.0100	-.0108	-.0083	-.0259	-.6723	-.4441
i=166	-.0364	.1375	.0271	.6833	.5479	-7.0937
i=167	-.0056	-.0143	.1517	.2653	6.9191	-.1064
i=168	.0100	-.0553	.0453	-.0796	1.7259	1.7974
i=169	.0115	-.0494	.0074	-.0176	-.1691	1.5235
i=170	-.0023	-.0326	.0090	.1255	-.0559	.7624
i=171	-.0447	.2113	.0385	1.0587	1.3968	-11.8523
i=172	-.0062	-.0377	.1847	-.0122	9.5559	1.1589
i=173	.0085	-.0695	.0400	-.2405	1.7398	2.8183
i=174	.0096	-.0472	.0161	-.0069	.3183	1.6873
i=175	.0025	-.0377	.0245	.2095	.7021	1.2764
i=176	-.0590	.2808	.1229	1.4714	6.5292	-16.6128
i=177	.0012	-.0792	.1891	-.3815	10.4967	3.5999
i=178	.0066	-.0693	.0322	-.3255	1.5343	3.0263
i=179	.0128	-.0606	.0206	-.0563	.6845	2.6018
i=180	.0071	-.0366	.0271	.2035	.8720	1.4086
i=181	-.0579	.2681	.3545	1.4012	21.1893	-16.9306
i=182	.0033	-.1145	.1379	-.7259	8.1364	5.9944
i=183	-.0066	-.0750	.0351	-.3955	1.9948	3.6347
i=184	.0176	-.1221	.0183	-.2139	.7751	6.5162
i=185	.0230	-.0261	.0431	.2019	1.9301	.9615
i=186	-.0051	-.3330	.4453	-2.1285	27.6484	19.8882
i=187	.2332	-.4032	.1016	-2.1123	5.1333	24.3072
i=188	.2948	-.3522	.0642	-1.2884	2.9750	21.1814
i=189	.2496	-.4717	-.0675	-.7247	-4.6828	28.6567
i=190	.0634	-.0260	.0378	.1049	1.7836	1.1334

Appendix VII The s60c08.pre File

Ship Name: s60c08

--------- Heading & Frequency: 170. .99707675

Pressure Distribution on the Port Side of the Ship

No	xc	yc	zc	p	phase
1	57.3691	.4016	-7.0857	.4498	-7.0583
2	54.1040	.4309	-7.0857	.3941	-19.0969
3	54.1040	1.2927	-7.0857	.4028	-18.6276
4	51.0496	.6766	-7.0857	.3403	-32.2891
5	51.0508	2.0274	-7.0857	.3583	-33.1042
6	46.2490	.5374	-7.0857	.2853	-2.9039
7	46.2490	1.6121	-7.0857	.2726	-5.7325
8	46.2491	2.6868	-7.0857	.2600	-14.7307
9	46.2444	3.7611	-7.0857	.2668	-23.8313
10	40.1657	.7571	-7.0857	.0618	2.7082
11	40.1657	2.2713	-7.0857	.0487	-22.0097
12	40.1657	3.7855	-7.0857	.0656	-71.1878
13	40.1679	5.2972	-7.0857	.1242	-85.4208
14	34.0531	.8918	-7.0857	.1801	-176.4519
15	34.0531	2.6754	-7.0857	.1804	-175.3390
16	34.0531	4.4590	-7.0857	.1791	-171.4498
17	34.0508	6.2410	-7.0857	.1793	-164.4685
18	27.8948	.9364	-7.0857	.3000	-174.5494
19	27.8948	2.8091	-7.0857	.2840	-178.0273
20	27.8948	4.6819	-7.0857	.2588	175.2758
21	27.8948	6.5546	-7.0857	.2395	164.4910
22	21.7000	.9411	-7.0857	.2462	-171.9659
23	21.7000	2.8232	-7.0857	.2267	-178.5834
24	21.7000	4.7054	-7.0857	.2048	166.2729
25	21.7000	6.5875	-7.0857	.2123	141.5465
26	15.5000	.9411	-7.0857	.0813	-152.2545
27	15.5000	2.8232	-7.0857	.0631	-170.3366
28	15.5000	4.7054	-7.0857	.0662	137.1273
29	15.5000	6.5875	-7.0857	.1385	102.3068
30	9.3000	.9411	-7.0857	.1116	-21.1922
31	9.3000	2.8232	-7.0857	.1064	-13.4863
32	9.3000	4.7054	-7.0857	.1005	6.4427
33	9.3000	6.5875	-7.0857	.1252	35.6178
34	3.1000	.9411	-7.0857	.1858	-10.7485
35	3.1000	2.8232	-7.0857	.1809	-11.7407
36	3.1000	4.7054	-7.0857	.1716	-11.4705

37	3.1000	6.5875	-7.0857	.1697	-8.8012
38	-3.1000	.9411	-7.0857	.1244	-8.7824
39	-3.1000	2.8232	-7.0857	.1280	-17.3660
40	-3.1000	4.7054	-7.0857	.1433	-29.0761
41	-3.1000	6.5875	-7.0857	.1838	-39.5524
42	-9.2979	.9392	-7.0857	.0413	-172.5875
43	-9.2979	2.8176	-7.0857	.0464	-132.9671
44	-9.2979	4.6960	-7.0857	.0862	-94.9652
45	-9.2979	6.5743	-7.0857	.1692	-78.7361
46	-15.4799	.9195	-7.0857	.2150	-176.7550
47	-15.4799	2.7586	-7.0857	.2011	-169.5753
48	-15.4799	4.5977	-7.0857	.1805	-152.5576
49	-15.4799	6.4368	-7.0857	.1909	-125.4046
50	-21.6431	.8554	-7.0857	.2817	-171.2654
51	-21.6431	2.5661	-7.0857	.2726	-169.8408
52	-21.6431	4.2768	-7.0857	.2525	-165.7605
53	-21.6431	5.9875	-7.0857	.2316	-157.5770
54	-27.7849	.7295	-7.0857	.1806	-159.3127
55	-27.7849	2.1885	-7.0857	.1827	-164.1860
56	-27.7849	3.6476	-7.0857	.1879	-171.4951
57	-27.7849	5.1066	-7.0857	.1862	-178.2941
58	-33.9237	.5568	-7.0857	.0430	-33.7264
59	-33.9237	1.6705	-7.0857	.0232	-15.1557
60	-33.9237	2.7841	-7.0857	.0253	95.4249
61	-33.9237	3.8977	-7.0857	.0608	105.2949
62	-40.0587	.3775	-7.0857	.1920	23.5879
63	-40.0587	1.1326	-7.0857	.1910	27.4304
64	-40.0587	1.8876	-7.0857	.1896	34.8925
65	-40.0587	2.6426	-7.0857	.1973	39.9496
66	-46.1402	.4386	-7.0857	.2679	41.1184
67	-46.1402	1.3159	-7.0857	.2770	41.9812
68	-51.0328	.4556	-7.0857	.3449	65.8029
69	-54.0727	.2680	-7.0857	.3450	51.1930
70	-57.1293	.1131	-7.0857	.3786	37.9361
71	59.8152	.4846	-6.7748	.8141	17.7846
72	60.0748	.8539	-5.9087	.8612	2.8292
73	60.1705	1.0880	-4.4182	1.0161	-8.0508
74	60.2664	1.1674	-2.6485	1.2554	-12.6381
75	60.3865	1.2273	-.8740	1.5635	-14.4683
76	57.2494	1.4733	-6.8028	.6001	6.0322
77	57.3094	2.5280	-5.9180	.8116	.7592
78	57.3363	3.1201	-4.4208	.9300	-17.3504
79	57.3460	3.3523	-2.6548	1.1400	-25.5288
80	57.3508	3.4994	-.8862	1.4162	-27.8873
81	54.2113	2.5501	-6.8134	.5078	-10.8874
82	54.2428	3.9488	-5.9314	.7038	-15.2887
83	54.2400	4.7580	-4.4229	.8397	-32.2690
84	54.2450	5.1355	-2.6543	1.0287	-42.2205
85	54.2492	5.3310	-.8853	1.2734	-46.1741
86	51.1456	3.6082	-6.8193	.4566	-29.7045
87	51.1493	5.1133	-5.9340	.6382	-37.5335
88	51.1483	5.9928	-4.4276	.7981	-53.2618
89	51.1488	6.4486	-2.6564	1.0059	-62.3398
90	51.1489	6.6832	-.8851	1.2632	-66.6070

91	46.5871	5.0544	-6.8275	.3768	-38.9553
92	46.5568	6.4458	-5.9457	.5662	-59.1486
93	46.5153	7.2359	-4.4329	.7374	-74.0725
94	46.5036	7.6458	-2.6582	.9519	-79.4010
95	46.5022	7.8646	-.8864	1.2826	-78.9525
96	40.4271	6.6844	-6.8309	.3049	-89.8603
97	40.3600	7.7593	-5.9463	.4892	-103.6132
98	40.3177	8.2873	-4.4336	.6306	-113.3985
99	40.3048	8.5275	-2.6585	.7775	-114.4207
100	40.3019	8.6548	-.8863	1.0120	-107.2475
101	34.1461	7.6842	-6.8239	.2509	-146.7873
102	34.1312	8.4731	-5.9405	.3982	-152.8430
103	34.1032	8.7330	-4.4295	.5465	-158.8128
104	34.1009	8.8084	-2.6574	.7062	-159.6214
105	34.1002	8.8453	-.8858	.8455	-152.4962
106	27.8992	8.0218	-6.8199	.2743	157.1622
107	27.9030	8.6965	-5.9349	.4129	156.9260
108	27.9001	8.8439	-4.4286	.5757	160.0940
109	27.9000	8.8542	-2.6572	.7634	164.2484
110	27.9000	8.8571	-.8857	.9164	168.1232
111	21.7000	8.0600	-6.8200	.2939	123.4770
112	21.7000	8.7243	-5.9343	.4423	120.7447
113	21.7000	8.8571	-4.4286	.5654	125.2263
114	21.7000	8.8571	-2.6571	.6964	131.4017
115	21.7000	8.8571	-.8857	.8625	133.7470
116	15.5000	8.0600	-6.8200	.2659	90.7040
117	15.5000	8.7243	-5.9343	.4282	86.1449
118	15.5000	8.8571	-4.4286	.5299	85.7575
119	15.5000	8.8571	-2.6571	.6141	87.2640
120	15.5000	8.8571	-.8857	.7757	91.2114
121	9.3000	8.0600	-6.8200	.2213	48.3357
122	9.3000	8.7243	-5.9343	.3972	46.3108
123	9.3000	8.8571	-4.4286	.5405	42.5836
124	9.3000	8.8571	-2.6571	.6765	39.8939
125	9.3000	8.8571	-.8857	.8034	44.1761
126	3.1000	8.0600	-6.8200	.2295	-3.0387
127	3.1000	8.7243	-5.9343	.4153	2.4436
128	3.1000	8.8571	-4.4286	.6083	3.6582
129	3.1000	8.8571	-2.6571	.8100	3.9070
130	3.1000	8.8571	-.8857	.9364	4.0329
131	-3.1000	8.0600	-6.8200	.2805	-41.1548
132	-3.1000	8.7243	-5.9343	.4658	-32.9488
133	-3.1000	8.8571	-4.4286	.6437	-26.8860
134	-3.1000	8.8571	-2.6571	.8321	-22.9105
135	-3.1000	8.8571	-.8857	.9904	-25.3161
136	-9.3017	8.0459	-6.8199	.2928	-71.5341
137	-9.3023	8.7158	-5.9338	.4453	-63.7618
138	-9.3000	8.8571	-4.4286	.5477	-57.9975
139	-9.3000	8.8571	-2.6571	.6362	-53.3567
140	-9.3000	8.8571	-.8857	.7713	-55.5793
141	-15.5397	7.9123	-6.8166	.2621	-109.4675
142	-15.5161	8.6460	-5.9311	.3736	-104.4902
143	-15.5001	8.8453	-4.4285	.4495	-107.6591
144	-15.5000	8.8571	-2.6571	.5036	-113.8911

145	-15.5000	8.8571	-.8857	.5913	-116.6353
146	-21.7527	7.4525	-6.8155	.2595	-161.5949
147	-21.7399	8.3476	-5.9263	.3817	-157.4773
148	-21.7061	8.7139	-4.4268	.5503	-156.4205
149	-21.7005	8.8306	-2.6570	.7394	-159.3450
150	-21.7000	8.8571	-.8857	.8780	-162.7791
151	-27.9667	6.5122	-6.8143	.2949	156.5750
152	-27.9586	7.6461	-5.9226	.4772	160.8730
153	-27.9195	8.3031	-4.4230	.6694	172.1807
154	-27.9047	8.6282	-2.6558	.8848	177.4413
155	-27.9013	8.7567	-.8853	1.0211	176.2211
156	-34.1494	5.2107	-6.8158	.2428	116.9810
157	-34.1073	6.5526	-5.9328	.4938	129.7632
158	-34.1289	7.4339	-4.4203	.6841	144.8186
159	-34.1192	8.0397	-2.6517	.8392	154.2216
160	-34.1074	8.3977	-.8836	.9319	153.4739
161	-40.2468	3.7893	-6.8246	.2740	65.0941
162	-40.2894	5.1052	-5.9364	.4767	95.9151
163	-40.3081	6.0929	-4.4263	.5911	113.6734
164	-40.3314	6.9469	-2.6482	.7101	124.1580
165	-40.3277	7.6196	-.8778	.8220	124.3758
166	-46.3902	2.3918	-6.8294	.3671	46.2002
167	-46.4485	3.4991	-5.9446	.4956	63.0221
168	-46.4808	4.3653	-4.4341	.5440	76.0039
169	-46.5219	5.3113	-2.6509	.5961	84.5399
170	-46.5622	6.3414	-.8679	.7129	90.2113
171	-51.0945	1.4320	-6.8295	.3897	54.8720
172	-51.1363	2.2491	-5.9398	.4973	59.0308
173	-51.1451	2.8835	-4.4313	.5332	68.3559
174	-51.1478	3.7909	-2.6584	.5657	75.8398
175	-51.1687	5.0974	-.8750	.6695	85.9344
176	-54.1763	.9035	-6.8326	.3980	37.5410
177	-54.2428	1.4435	-5.9372	.4940	42.3548
178	-54.2479	1.8515	-4.4298	.5170	47.9265
179	-54.2417	2.5738	-2.6619	.5286	50.8908
180	-54.2727	3.9731	-.8728	.5624	59.7950
181	-57.2659	.4302	-6.8344	.4638	23.4233
182	-57.3491	.6560	-5.9346	.5435	30.2058
183	-57.3534	.8272	-4.4266	.5832	31.3421
184	-57.3460	1.2308	-2.6594	.6112	29.8761
185	-57.3689	2.6088	-.8749	.6045	32.4777
186	-59.2633	.0957	-6.8194	.5825	24.0596
187	-59.2640	.1312	-5.9317	.6778	28.3918
188	-59.2633	.1503	-4.4267	.7560	26.6623
189	-59.3320	.2519	-2.6033	.7839	25.5277
190	-60.6873	1.4744	-.6808	.7527	14.1612

Pressure Distribution on the Starboard Side of the Ship

No	xc	yc	zc	p	phase
1	57.3691	-.4016	-7.0857	.4463	-5.8232
2	54.1040	-.4309	-7.0857	.3957	-18.0500

3	54.1040	-1.2927	-7.0857	.4059	-15.3586
4	51.0496	-.6766	-7.0857	.3444	-30.6661
5	51.0508	-2.0274	-7.0857	.3694	-28.2524
6	46.2490	-.5374	-7.0857	.2901	-2.6600
7	46.2490	-1.6121	-7.0857	.2872	-5.7777
8	46.2491	-2.6868	-7.0857	.2849	-12.2653
9	46.2444	-3.7611	-7.0857	.3022	-18.8216
10	40.1657	-.7571	-7.0857	.0674	.7978
11	40.1657	-2.2713	-7.0857	.0673	-21.5781
12	40.1657	-3.7855	-7.0857	.0913	-55.1811
13	40.1679	-5.2972	-7.0857	.1578	-67.6148
14	34.0531	-.8918	-7.0857	.1770	-174.7231
15	34.0531	-2.6754	-7.0857	.1723	-169.6343
16	34.0531	-4.4590	-7.0857	.1704	-160.3375
17	34.0508	-6.2410	-7.0857	.1803	-145.8132
18	27.8948	-.9364	-7.0857	.3016	-173.4501
19	27.8948	-2.8091	-7.0857	.2888	-174.4111
20	27.8948	-4.6819	-7.0857	.2670	-177.4823
21	27.8948	-6.5546	-7.0857	.2511	177.7433
22	21.7000	-.9411	-7.0857	.2516	-171.3255
23	21.7000	-2.8232	-7.0857	.2431	-176.1401
24	21.7000	-4.7054	-7.0857	.2311	172.5269
25	21.7000	-6.5875	-7.0857	.2427	154.6934
26	15.5000	-.9411	-7.0857	.0869	-154.5766
27	15.5000	-2.8232	-7.0857	.0832	-174.0374
28	15.5000	-4.7054	-7.0857	.0993	150.0492
29	15.5000	-6.5875	-7.0857	.1719	122.4134
30	9.3000	-.9411	-7.0857	.1050	-19.9173
31	9.3000	-2.8232	-7.0857	.0877	-6.7891
32	9.3000	-4.7054	-7.0857	.0804	28.2466
33	9.3000	-6.5875	-7.0857	.1305	64.9844
34	3.1000	-.9411	-7.0857	.1825	-8.6477
35	3.1000	-2.8232	-7.0857	.1718	-4.8157
36	3.1000	-4.7054	-7.0857	.1587	2.2469
37	3.1000	-6.5875	-7.0857	.1595	14.5279
38	-3.1000	-.9411	-7.0857	.1255	-5.2445
39	-3.1000	-2.8232	-7.0857	.1296	-6.6810
40	-3.1000	-4.7054	-7.0857	.1414	-11.8257
41	-3.1000	-6.5875	-7.0857	.1745	-17.6611
42	-9.2979	-.9392	-7.0857	.0354	-179.9367
43	-9.2979	-2.8176	-7.0857	.0229	-128.1824
44	-9.2979	-4.6960	-7.0857	.0641	-67.3598
45	-9.2979	-6.5743	-7.0857	.1541	-55.4144
46	-15.4799	-.9195	-7.0857	.2077	-176.9601
47	-15.4799	-2.7586	-7.0857	.1787	-169.2095
48	-15.4799	-4.5977	-7.0857	.1447	-146.3560
49	-15.4799	-6.4368	-7.0857	.1633	-106.5200
50	-21.6431	-.8554	-7.0857	.2764	-170.4230
51	-21.6431	-2.5661	-7.0857	.2572	-166.8562
52	-21.6431	-4.2768	-7.0857	.2294	-158.9576
53	-21.6431	-5.9875	-7.0857	.2107	-143.2509
54	-27.7849	-.7295	-7.0857	.1808	-157.4255
55	-27.7849	-2.1885	-7.0857	.1829	-158.4353
56	-27.7849	-3.6476	-7.0857	.1871	-161.5781

57	-27.7849	-5.1066	-7.0857	.1875	-162.4688
58	-33.9237	-.5568	-7.0857	.0443	-40.4832
59	-33.9237	-1.6705	-7.0857	.0261	-53.0294
60	-33.9237	-2.7841	-7.0857	.0154	-179.0684
61	-33.9237	-3.8977	-7.0857	.0454	152.0755
62	-40.0587	-.3775	-7.0857	.1879	23.5299
63	-40.0587	-1.1326	-7.0857	.1783	27.5898
64	-40.0587	-1.8876	-7.0857	.1680	36.5004
65	-40.0587	-2.6426	-7.0857	.1666	44.4980
66	-46.1402	-.4386	-7.0857	.2659	42.2800
67	-46.1402	-1.3159	-7.0857	.2733	45.8506
68	-51.0328	-.4556	-7.0857	.3565	66.3757
69	-54.0727	-.2680	-7.0857	.3589	51.1902
70	-57.1293	-.1131	-7.0857	.3955	36.7011
71	59.8152	-.4846	-6.7748	.7694	21.6831
72	60.0748	-.8539	-5.9087	.9376	5.2500
73	60.1705	-1.0880	-4.4182	1.1512	-5.0247
74	60.2664	-1.1674	-2.6485	1.4351	-9.3941
75	60.3865	-1.2273	-.8740	1.8071	-11.1989
76	57.2494	-1.4733	-6.8028	.5844	11.7630
77	57.3094	-2.5280	-5.9180	.8376	7.7983
78	57.3363	-3.1201	-4.4208	1.0273	-9.3529
79	57.3460	-3.3523	-2.6548	1.2991	-16.9976
80	57.3508	-3.4994	-.8862	1.6485	-19.2571
81	54.2113	-2.5501	-6.8134	.5136	-3.7855
82	54.2428	-3.9488	-5.9314	.7391	-5.7617
83	54.2400	-4.7580	-4.4229	.9235	-21.2433
84	54.2450	-5.1355	-2.6543	1.1652	-30.3234
85	54.2492	-5.3310	-.8853	1.4749	-34.0014
86	51.1456	-3.6082	-6.8193	.4762	-20.9901
87	51.1493	-5.1133	-5.9340	.6802	-26.4282
88	51.1483	-5.9928	-4.4276	.8704	-40.7772
89	51.1488	-6.4486	-2.6564	1.1138	-49.2640
90	51.1489	-6.6832	-.8851	1.4174	-53.4277
91	46.5871	-5.0544	-6.8275	.4245	-29.4084
92	46.5568	-6.4458	-5.9457	.6361	-47.2463
93	46.5153	-7.2359	-4.4329	.8379	-61.2215
94	46.5036	-7.6458	-2.6582	1.0945	-66.6731
95	46.5022	-7.8646	-.8864	1.4865	-67.5293
96	40.4271	-6.6844	-6.8309	.3563	-75.1122
97	40.3600	-7.7593	-5.9463	.5721	-89.7329
98	40.3177	-8.2873	-4.4336	.7453	-99.3906
99	40.3048	-8.5275	-2.6585	.9348	-100.9770
100	40.3019	-8.6548	-.8863	1.2456	-96.4602
101	34.1461	-7.6842	-6.8239	.2949	-126.5439
102	34.1312	-8.4731	-5.9405	.4842	-134.5453
103	34.1032	-8.7330	-4.4295	.6586	-141.5306
104	34.1009	-8.8084	-2.6574	.8516	-143.9152
105	34.1002	-8.8453	-.8858	1.0666	-139.1858
106	27.8992	-8.0218	-6.8199	.3007	177.4995
107	27.9030	-8.6965	-5.9349	.4790	177.6360
108	27.9001	-8.8439	-4.4286	.6827	177.7894
109	27.9000	-8.8542	-2.6572	.9205	178.7022
110	27.9000	-8.8571	-.8857	1.1431	-179.4491

111	21.7000	-8.0600	-6.8200	.3301	142.5002
112	21.7000	-8.7243	-5.9343	.5108	141.0541
113	21.7000	-8.8571	-4.4286	.6832	143.6883
114	21.7000	-8.8571	-2.6571	.8791	146.8468
115	21.7000	-8.8571	-.8857	1.1174	146.8789
116	15.5000	-8.0600	-6.8200	.3094	111.6541
117	15.5000	-8.7243	-5.9343	.4978	107.6499
118	15.5000	-8.8571	-4.4286	.6339	107.0642
119	15.5000	-8.8571	-2.6571	.7689	107.6466
120	15.5000	-8.8571	-.8857	1.0070	108.5897
121	9.3000	-8.0600	-6.8200	.2558	74.5944
122	9.3000	-8.7243	-5.9343	.4536	70.2186
123	9.3000	-8.8571	-4.4286	.6124	65.1878
124	9.3000	-8.8571	-2.6571	.7741	61.3821
125	9.3000	-8.8571	-.8857	.9766	64.1114
126	3.1000	-8.0600	-6.8200	.2339	25.7112
127	3.1000	-8.7243	-5.9343	.4466	27.0228
128	3.1000	-8.8571	-4.4286	.6647	24.7589
129	3.1000	-8.8571	-2.6571	.9013	22.6714
130	3.1000	-8.8571	-.8857	1.0857	22.9400
131	-3.1000	-8.0600	-6.8200	.2712	-16.9530
132	-3.1000	-8.7243	-5.9343	.4909	-10.6863
133	-3.1000	-8.8571	-4.4286	.7135	-7.3623
134	-3.1000	-8.8571	-2.6571	.9555	-5.6854
135	-3.1000	-8.8571	-.8857	1.1608	-8.0340
136	-9.3017	-8.0459	-6.8199	.2910	-49.1994
137	-9.3023	-8.7158	-5.9338	.4848	-41.7642
138	-9.3000	-8.8571	-4.4286	.6382	-36.9654
139	-9.3000	-8.8571	-2.6571	.7881	-33.7334
140	-9.3000	-8.8571	-.8857	.9751	-36.5969
141	-15.5397	-7.9123	-6.8166	.2628	-85.6491
142	-15.5161	-8.6460	-5.9311	.4048	-78.3624
143	-15.5001	-8.8453	-4.4285	.5031	-79.5859
144	-15.5000	-8.8571	-2.6571	.5744	-83.2867
145	-15.5000	-8.8571	-.8857	.7028	-85.4247
146	-21.7527	-7.4525	-6.8155	.2391	-139.1211
147	-21.7399	-8.3476	-5.9263	.3559	-131.6582
148	-21.7061	-8.7139	-4.4268	.5276	-131.4732
149	-21.7005	-8.8306	-2.6570	.7202	-135.8515
150	-21.7000	-8.8571	-.8857	.8725	-138.0447
151	-27.9667	-6.5122	-6.8143	.2743	173.6335
152	-27.9586	-7.6461	-5.9226	.4359	178.3843
153	-27.9195	-8.3031	-4.4230	.6438	-169.2918
154	-27.9047	-8.6282	-2.6558	.8953	-164.3552
155	-27.9013	-8.7567	-.8853	1.0641	-164.1238
156	-34.1494	-5.2107	-6.8158	.2257	135.2043
157	-34.1073	-6.5526	-5.9328	.4727	144.9607
158	-34.1289	-7.4339	-4.4203	.6826	161.0027
159	-34.1192	-8.0397	-2.6517	.8855	171.6167
160	-34.1074	-8.3977	-.8836	1.0177	173.2225
161	-40.2468	-3.7893	-6.8246	.2441	76.6722
162	-40.2894	-5.1052	-5.9364	.4614	108.8088
163	-40.3081	-6.0929	-4.4263	.5936	128.9784
164	-40.3314	-6.9469	-2.6482	.7438	141.2681

165	-40.3277	-7.6196	-.8778	.8764	143.6923
166	-46.3902	-2.3918	-6.8294	.3692	53.1958
167	-46.4485	-3.4991	-5.9446	.5006	72.2544
168	-46.4808	-4.3653	-4.4341	.5523	88.0087
169	-46.5219	-5.3113	-2.6509	.6186	98.5016
170	-46.5622	-6.3414	-.8679	.7550	104.5158
171	-51.0945	-1.4320	-6.8295	.4359	57.6781
172	-51.1363	-2.2491	-5.9398	.5488	64.7317
173	-51.1451	-2.8835	-4.4313	.5922	76.4853
174	-51.1478	-3.7909	-2.6584	.6495	85.0180
175	-51.1687	-5.0974	-.8750	.7975	93.8521
176	-54.1763	-.9035	-6.8326	.4570	40.0209
177	-54.2428	-1.4435	-5.9372	.5439	49.2968
178	-54.2479	-1.8515	-4.4298	.5704	58.3433
179	-54.2417	-2.5738	-2.6619	.6030	63.3756
180	-54.2727	-3.9731	-.8728	.6949	71.1816
181	-57.2659	-.4302	-6.8344	.5174	26.3965
182	-57.3491	-.6560	-5.9346	.5479	39.3767
183	-57.3534	-.8272	-4.4266	.5764	44.2328
184	-57.3460	-1.2308	-2.6594	.6121	44.5998
185	-57.3689	-2.6088	-.8749	.6783	46.9822
186	-59.2633	-.0957	-6.8194	.5297	29.4660
187	-59.2640	-.1312	-5.9317	.5400	41.4292
188	-59.2633	-.1503	-4.4267	.5913	41.3737
189	-59.3320	-.2519	-2.6033	.6480	39.0252
190	-60.6873	-1.4744	-.6808	.7692	23.2834

UNCLASSIFIED
SECURITY CLASSIFICATION OF FORM
(highest classification of Title, Abstract, Keywords)

DOCUMENT CONTROL DATA

(Security classification of title, body of abstract and indexing annotation must be entered when the overall document is classified)

1. ORIGINATOR (the name and address of the organization preparing the document.. Organizations for whom the document was prepared, e.g. Establishment sponsoring a contractor's report, or tasking agency, are entered in section 8.)

Centre for Marine Vessel Development and Research
DalTech, Dalhousie University,
P.O. Box 1000, Halifax, NS B3J 2X4

2. SECURITY CLASSIFICATION (overall security classification of the document including special warning terms if applicable).

UNCLASSIFIED

3. TITLE (the complete document title as indicated on the title page. Its classification should be indicated by the appropriate abbreviation (S,C,R or U) in parentheses after the title).

User's Manual for WAVELOAD version 1: A Computer Program for the Prediction of Ship Motions, Hydrodynamic Pressure Distribution, and Sea Loads

4. AUTHORS (Last name, first name, middle initial. If military, show rank, e.g. Doe, Maj. John E.)

Hsiung, C.C. , Huang, Z.J., and Qiu, W.

5. DATE OF PUBLICATION (month and year of publication of document)	6a. NO .OF PAGES (total containing information Include Annexes, Appendices, etc).	6b. NO. OF REFS (total cited in document)
November 1998	ii, 73	3

7. DESCRIPTIVE NOTES (the category of the document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of report, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered).

CONTRACTOR REPORT

8. SPONSORING ACTIVITY (the name of the department project office or laboratory sponsoring the research and development. Include address).

Defence Research Establishment Atlantic
PO Box 1012
Dartmouth, NS, Canada B2Y 3Z7

9a. PROJECT OR GRANT NO. (if appropriate, the applicable research and development project or grant number under which the document was written. Please specify whether project or grant).	9b. CONTRACT NO. (if appropriate, the applicable number under which the document was written).
1gb13	W7707-7-4636

10a ORIGINATOR'S DOCUMENT NUMBER (the official document number by which the document is identified by the originating activity. This number must be unique to this document.)	10b OTHER DOCUMENT NOs. (Any other numbers which may be assigned this document either by the originator or by the sponsor.)
DREA CR/98/445	

11. DOCUMENT AVAILABILITY (any limitations on further dissemination of the document, other than those imposed by security classification)

(X) Unlimited distribution
( ) Defence departments and defence contractors; further distribution only as approved
( ) Defence departments and Canadian defence contractors; further distribution only as approved
( ) Government departments and agencies; further distribution only as approved
( ) Defence departments; further distribution only as approved
( ) Other (please specify):

12. DOCUMENT ANNOUNCEMENT (any limitation to the bibliographic announcement of this document. This will normally correspond to the Document Availability (11). However, where further distribution (beyond the audience specified in (11) is possible, a wider announcement audience may be selected).

UNCLASSIFIED
SECURITY CLASSIFICATION OF FORM

13. ABSTRACT (a brief and factual summary of the document. It may also appear elsewhere in the body of the document itself. It is highly desirable that the abstract of classified documents be unclassified. Each paragraph of the abstract shall begin with an indication of the security classification of the information in the paragraph (unless the document itself is unclassified) represented as (S), (C), (R), or (U). It is not necessary to include here abstracts in both official languages unless the text is bilingual).

WAVELOAD is a computer program which has been developed to provide a numerical tool for predicting ship motions, sea loads and the hydrodynamic pressure distribution over the wetted hull surface in the frequency domain. The computations are based on the three-dimensional panel method using zero-speed Green's function with forward speed correction. The *m*-term effect on the ship motion is considered.

This manual describes how to install and operate the WAVELOAD version 1.0 program on a FreeBSD UNIX system. The structure of the input and output data files are described in detail. Example files are also included in this manual.

14. KEYWORDS, DESCRIPTORS or IDENTIFIERS (technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus-identified. If it not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title).

ship motions
sea loads
hydrodynamic pressures
frequency domain
3-dimensional panel method
computer program manual